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THE NEARCTIC SOCIAL WASPS OF THE SUBFAMILY POLYBIINAE (HYMENOPTERA; VESPIDAE)

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The so-called social wasps of the New World are now placed in three subfamilies, *viz.*, the Vespinae, Polistinae, and Polybiinae. These three groups are so distinct, structurally, that I must regard them as forming at least as many genealogical lines, each of them derived from its own ancestral stock of solitary wasps. Whatever similarity in habits they now exhibit is solely due to convergence and caused by the unavoidable reaction of communal life upon individual behavior.

In the New World, the Vespinae are restricted to North America, where they are represented by a number of species of the Holarctic genus *Vespula* (and one introduced *Vespa*). I have recently published a revision of these wasps. The Polistinae are a cosmopolitan group consisting of a single genus, *Polistes*, with many, rather closely allied, species. In the Nearctic Region this genus comprises not more than half a dozen species distinguishable by peculiarities of structure; but some of these species vary tremendously in color. Contrasting with the foregoing two groups, the Polybiinae are essentially a tropical subfamily. They are especially numerous in the American tropics, where they offer so much variety in structure and habits, that one may well raise the question whether they are not a composite, or polyphyletic, group.

Only three species of Polybiinae are known to occur within the political boundaries of the United States, and only one of these extends into the Dominion of Canada. Two genera only, *Nectarina* and *Mischocyttarus*, are represented, and it is important to note at once that these genera have many representatives in the Neotropical Region. Moreover, of the three species, only one (*M. flavitarsis*) is a precinctive Nearctic insect; a second species (*M. cubensis*) is a West Indian wasp that has invaded the southeastern United States; while the third (*N. lecheguana*) is a common and widely distributed South and Central American insect that barely crosses the Mexican border into Arizona and Texas. It would therefore seem that the Polybiine fauna of the Nearctic Region is unquestionably of Neotropical origin. At least two of the three species most probably extended their range into Nearctic territory after the close of the last Glacial Period.

KEY TO NEARCTIC GENERA

- Third and fourth segments of mid and hind tarsi with the inner lobe produced and decidedly longer than the outer lobe. Body long and slender, the abdomen much narrowed at the base; first segment stalk-like. Scutellum and postscutellum forming one continuous slope. Eyes bare *Mischocyttarus*.
- Third and fourth segments of mid and hind tarsi with the inner and outer lobes equally developed. Body short and stubby, the abdomen broadly rounded off at base; the first segment not stalk-like, very short and flattened against the much broader second segment. Scutellum mostly horizontal, its hind portion forming a protruding ledge over the vertical postscutellum. Eyes pubescent *Nectarina*.

Mention should be made here of *Polybia saussurei* A. E. Holmgren (1868, Kongl. Svenska Freg. Eugenies Resa, Vet. Iakt., II, Zool., 1, Insecta, Hym., p. 440; ♀ ♂), described from "California et Puna." So far as I was able to discover, this insect has not been recognized since, although the types are in the Stockholm Museum. The description does not mention the characters needed to place it in one of the modern genera of Polybiinae. It is not impossible that it is a *Mischocyttarus*, but the coloration and small size (length, 8 to 10 mm.) exclude *M. flavitarsis* and the size is even too small for *M. cubensis* var. *mexicanus*. In any case, the locality "California" must have been due to an error in labelling the specimens. No wasp even remotely like the description of *P. saussurei*

has since been taken in the western United States.¹ The conclusion seems therefore warranted that the type locality of *P. saussurei* was the island of Puna, in the Gulf of Guayaquil, Ecuador.

Nectarina Swainson and Shuckard

Brachygastra Perty, 1833, *Delectus Anim. Articul. Brasil.*, p. 145 (for two species: *Brachygastra analis* Perty, 1833, and *B. scutellaris* Perty, 1833; type by present designation: *Brachygastra analis* Perty = *Polistes lecheguana* Latreille, 1824). Not *Brachygaster* Leach, 1815.²

Brachygaster H. de Saussure, 1852, *Et. Fam. Vesp.*, I, p. 171, footnote (misspelling of *Brachygastra* Perty).

Nectarina Swainson and Shuckard, 1840, *On the History and Natural Arrangement of Insects*, p. 183, footnote (substitute for *Brachygastra* Perty, 1833;³ type by designation of Ashmead, 1902, *Canad. Entom.*, XXXIV, p. 165: *Brachygastra analis* Perty, 1833 = *Polistes lecheguana* Latreille, 1824). Not *Nectarinia* Illiger, 1811.

Nectarinia H. de Saussure, 1853–1855, *Et. Fam. Vesp.*, II, p. 225 (misspelling of *Nectarina* Swainson and Shuckard).

Melissaia Shuckard, 1841, in White, *Ann. Mag. Nat. Hist.*, VII, p. 320, footnote (substitute for *Nectarina* Swainson and Shuckard, 1840).

Caba R. von Ihering, 1904, *Rev. Mus. Paulista*, VI, pp. 103 and 105 (substitute for *Nectarina* Swainson and Shuckard, 1840).

Generic Characters.—Body thickset. Head broad and short; eyes covered with short, scattered hairs, more numerous in the upper half; inner orbits distinctly but moderately

¹ The Frigate *Eugenie* called at many ports on the west coast of South and North America. But in California the Expedition visited only San Francisco. So much collecting has been done near that city, that *P. saussurei* could hardly have escaped notice since 1868.

² If *Nectarina* and *Nectarinia* are both regarded as valid names, as well as *Polybia* and *Polybius*, there seems to be no reason why *Brachygaster* Leach and *Brachygastra* Perty should be treated as homonyms. In view of the general use of *Nectarina*, I feel, however, reluctant to return to the oldest generic name of the honeywasps.

³ The name should be credited to Swainson and Shuckard jointly, since the footnote uses “we” and is not signed with Shuckard’s initials (see introductory note of the “History and Natural Arrangement of Insects”).

emarginate; ocelli normal; oculo-malar space short, rudimentary or absent; genae broad, separated from the postgenae by a strong carina which reaches the base of the mandibles and continues behind the vertex; clypeus short, its lower portion broadly triangular and bluntly rounded off at apex; mandibles rather narrow, the apical or cutting edge oblique and with four unequal teeth; maxillary palpi 6-jointed; labial palpi 4-jointed, the apical segment without erect inner seta. Antennae of 12 segments in female and worker; of 13 segments in male, all the segments normal. Thorax short and thick, cubic; anterior margin of pronotum truncate, dorsally with a raised rim which stops at or slightly below the humeri, where it forms right angles; mesonotum without notauli; scutellum very large, wider than long; its median portion with an anterior, horizontal area and a posterior, vertical portion, the two separated by a raised edge or ridge, usually somewhat concave in the middle; postscutellum (true metanotum) vertical, its posterior margin a deep, transverse, straight groove, which divides it from the propodeum as well as from the median propodeal area; postscutellum in a plane with the hind portion of the scutellum and hidden (when viewed from above) by the more or less protruding transverse edge of the scutellum; propodeum very short, its sides swollen and with a raised ridge or a strong angle, its median portion vertical and slightly concave, at the base with a distinct median, cordate area;⁴ valvae surrounding the retractor muscle low, forming a broadly oval dorsal orifice; mesopleura without even a trace of mesepisternal suture and without epinenial suture; mesepimeral suture obsolete or very slightly developed. Abdomen short and broad, globular, consisting mostly of the very large, swollen, bell-shaped second segment, in which the succeeding segments may be almost completely retracted; first tergite very short, much narrower than the second, scale-like and flattened against the second tergite, its narrow base, articulating with the propodeum, very short, not stalk-like, its spiracles more or less prominent, placed close to the hind margin; second sternite shorter than the second tergite, abruptly sloping at the base; sting strongly barbed. Legs rather short, of normal shape; lateral lobes of tarsal segments and claws symmetrical; mid tibiae with two apical spurs. Wings short; venation of the usual vespid type; fore wing:

⁴ A comparative study of the postscutellum and base of propodeum in the Vespidae seems to indicate that this "basal area" of the propodeum was originally part of the postscutellum and homologous with the produced hind portion which in Vespinae and in *Protopolybia* is wedged in the base of the propodeum, from which it is distinctly divided.

basal vein ending close to the stigma; radial cell much narrowed and pointed in its apical half; second cubital cell narrow, always much higher than wide; hind wing with few hooks (6 to 9), a broad but rather short basal (or posterior) lobe, and a distinct preaxillary excision; discoidella leaving the nervellus at about the upper third, far below the origin of the cubitella. The males differ from the queens and workers mainly in the narrower head and the elongate clypeus. Externally queens and workers are alike, though the former are slightly larger, with more swollen abdomen. H. von Ihering (1896), upon examining a number of females of *N. lecheguana*, found that in some the spermatheca was rudimentary and these he regarded as workers.⁵

Taxonomy.—*Nectarina* contains seven species separable by structural peculiarities, viz., *N. augusti* (H. de Saussure), *N. azteca* (H. de Saussure), *N. baccalaurea* (R. v. Ihering), *N. bilineolata* (Spinola), *N. buyssoni* Ducke, *N. lecheguana* (Latreille), and *N. scutellaris* (Fabricius). I have seen specimens of all.⁶ They differ mainly in the shape of scutellum and propodeum, the sculpture, and the development of the oculo-malar space (this is much longer in *N. bilineolata* than in most of the other species). Each species appears to have a more or less characteristic color pattern, although some of them show a fairly pronounced geographical variation in color.

Distribution.—The genus *Nectarina* is one of the most typical elements of the Neotropical fauna. It extends from southern Arizona (northernmost locality: Nogales, in about 32° lat. N.) to northern Argentina (southernmost locality: Buenos Aires, in about 35° lat. S.); it is not known to occur within the political boundaries of Chile and is entirely absent from the Antilles, though quite common in Yucatan and Trinidad. One of the species (*N. lecheguana*) covers the whole of this territory, but the others are much more restricted in distribution. *N. azteca* is known only from southern

⁵ R. du Buysson's account of the morphology of *Nectarina* (1905, Ann. Soc. Ent. France, LXXIV, pp. 540-542, Pls. XI-XII), although quite extensive and well illustrated, does not mention some of the most important features of the genus, nor does it point out those that are diagnostic.

⁶ *Nectarina championi* Dover, 1925, Psyche, XXXI, (1924), p. 305, fig. 1 (♀), from Chiriquí, Panama, is not a *Nectarina*, as I suspected from the description. Paratypes kindly sent to me by Mr. Hugh Scott show that it is a *Parachartergus*, related to *P. frontalis* (Fabricius), though quite distinct.

Mexico (States of Tepic, Michoacán, México, Puebla, Guerrero and Oaxaca). *N. baccalaurea* is a species of the Andes of Peru and Ecuador (at about 1,600 m. altitude). *N. buyssoni* is known from only a few places on the Upper Amazon and Madeira Rivers (Tabatinga in Brazil; Iquitos in Peru; I have seen a specimen from Tumupasa, Bolivia). *N. augusti* and *N. bilineolata* have much the same distribution, being known from Guatemala to southern Brazil and Paraguay. *N. scutellaris* is strictly South American (from Colombia to São Paulo, Brazil). Four of the species occur in North America, one of them being endemic there.⁷

Ethology.—The nests are known of *N. augusti*, *N. azteca*, *N. bilineolata*, *N. scutellaris* and *N. lecheguana*. They agree in their general architecture, although each species shows certain definite building characteristics. The nest is aerial, entirely made of paper or cardboard and of the “phragmocyttarous” type, consisting of few combs (usually less than ten) of hexagonal cells enclosed in an envelope (calyptodomous), with one or more openings for ingress and egress; the first comb is attached directly to the support by its whole under surface and the succeeding combs are built on the lower surface of the envelope and later enclosed by lateral extension of the cover. In conical nests, the several combs are placed one above the other; in spherical nests they are more or less concentric. The entrance is either circular or slit-like and generally placed on one of the lower sides, the holes in the successive combs being also more or less eccentric. All five species mentioned above are polygynous, the nest containing several fertile, ovipositing females (queens). A new nest is started by a swarm leaving an old colony; and since the swarm contains several queens, in addition to many workers, these wasps are typically pleometrotic. So far as known, all species store honey, often in large quantities, which perhaps helps the colony to survive through the winter or dry season, so that the nest may persist for several years. Moreover, so far as published observations go, it would seem that the larvae of *Nectarina* are fed exclusively or mainly with honey and pollen.

Nectarina lecheguana (Latreille)

Text Figure 1. Plates XXVII and XXVIII

Polistes lecheguana Latreille, 1824, Mém. Mus. Hist. Nat., Paris, XI, p. 317 (♂; Brazil, without more definite locality; holotype in

⁷ I have seen *N. bilineolata* from Tegucigalpa, Rep. Honduras, and *N. augusti* from Columbian Farm, Sta. Clara Prov., Costa Rica.

Paris Museum); 1825, Ann. Sc. Nat., IV, p. 339. Aug. de St. Hilaire, 1825, Mém. Mus. Hist. Nat., Paris, XII, Pl. XII, fig. B; 1830, Voyage dans les Provinces de Rio de Janeiro et de Minas Geraes, II, p. 375, footnote.

Vespa lecheguana Swainson and Shuckard, 1840, On the History and Natural Arrangement of Insects, p. 183.

Polistes (Brachygastra) lecheguana White, 1841, Ann. Mag. Nat. Hist., VII, p. 319, footnote.

Epipone lecheguana Curtis, 1844, Proc. Linn. Soc. London, I, No. 20, p. 188; 1844, Trans. Linn. Soc. London, XIX, pt. 3, p. 258.

Nectarinia lecheguana H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 232, Pl. XXX (nest, described on p. cxxxiv) and Pl. XXXIV, figs. 1, 1a-c, 3 and 3a-c (♀ ♀). Dalla Torre, 1894, Cat. Hym., IX, p. 170. Fox, 1898, Proc. Ac. Nat. Sci. Philadelphia, p. 460. Holmberg, 1898, Segundo Censo Republ. Argentina, I, p. 590. Schrottky, 1902, An. Mus. Nac. Buenos Aires, (3) I, p. 116; 1903, An. Soc. Cient. Argentina, LV, p. 179. Brèthes, 1903, An. Mus. Nac. Buenos Aires, (3) II, p. 16. Cockerell, 1927, Proc. U. S. Nat. Mus., LXXI, Art. 12, p. 2.

Nectarina lecheguana F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 136; 1863, Trans. Ent. Soc. London, (3) I, pp. 501-503; 1864, *Loc. cit.*, (3) II, p. 135. Dalla Torre, 1904, Gen. Ins., Vesp., p. 86. R. du Buysson, 1905, Ann. Soc. Ent. France, LXXIV, pp. 542, 547 and 558, Pl. XI, figs. 1-7; Pl. XII, figs. 1-3, 6-8, 10 and 13; Pl. XV; and Pl. XVI (♀ ♀ ♂). Brèthes, 1906, An. Mus. Nac. Buenos Aires, (3) VI, p. 313. Ducke, 1906, Rev. d'Entom., Caen, XXV, p. 6; 1907, Bol. Mus. Goeldi (Pará), V, pp. 155 and 157; 1908, Rev. d'Entom., Caen, XXVII, p. 84. Schrottky, 1908, Zeitschr. Wiss. Insektenbiol., IV, pp. 24 and 52; 1909, *Loc. cit.*, V, pp. 210 and 212. Ducke, 1910, Ann. Mus. Nat. Hungarici, VIII, pp. 479 and 481 (♀ ♂). R. du Buysson, 1910, Zool. Jahrb., Abt. Syst., XXIX, p. 231. A. de W. Bertoni, 1911, An. Mus. Nac. Buenos Aires, (3) XV, p. 115. Meade Waldo, 1911, Ann. Mag. Nat. Hist., (8) VII, p. 111; 1914, *Loc. cit.*, (8) XIV, p. 406. Rohwer, 1914, Proc. U. S. Nat. Mus., XLVII, p. 513. Ducke, 1916, Comm. Linhas Telegr. Estrat. Matto Grosso, Publ. No. 35, Ann. No. 5, Hym., p. 7; 1918, Rev. Mus. Paulista, X, p. 327. Bodkin, 1918, Trans. Ent. Soc. London, (1917), pts. 2-4, p. 309. Bradley, 1921, Actes Soc. Scientif. Chili, XXX, (1920), p. 57. Pellett, 1922, Science, LV, p. 644. Dover, 1925, Psyche, XXXI, pt. 6, (1924), p. 307. Fonseca, 1926, Rev. Mus. Paulista, XIV, (1925), p. 171. Stiles

- and Hassall, 1928, U. S. Publ. Health Serv., Hyg. Labor., Bull. 150, p. 396. H. F. Schwarz, 1928, Jl. New York Ent. Soc., XXXVI, p. 460; 1929, Natural History, New York, XXIX, p. 425. Salt and Bequaert, 1929, Psyche, XXXVI, p. 261.
- Caba lecheguana* R. v. Ihering, 1904, Rev. Mus. Paulista, VI, pp. 106, 109 and 233 (♀ ♂).
- Vespa sericea* Fabricius, 1804, Syst. Piezat., p. 266 (no sex; "in America meridionali"). Not *Vespa sericea* Olivier, 1791.
- Brachygastra sericea* Erichson, 1848, in Schomburgk, Reisen in Britisch Guiana, III, p. 590.
- Chartergus sericeus* Möbius, 1856, Abh. Naturw. Ver. Hamburg, III, p. 144, Pl. XVI. Dalla Torre, 1894, Cat. Hym., IX, p. 169; 1904, Gen. Ins., Vesp., p. 85.
- Brachygastra analis* Perty, 1833, Delectus Anim. Artic. Brasil., p. 146, Pl. XXVIII, fig. 6 (no sex given, but from the figure evidently ♀; State of Piahy, Brazil). Spinola, 1841, Ann. Soc. Ent. France, X, p. 127 (♀).
- Nectarina analis* in Swainson and Shuckard, 1840, on the History and Natural Arrangement of Insects, p. 183, footnote. F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 136; 1862, Trans. Ent. Soc. London, (3) I, p. 39. Dalla Torre, 1904, Gen. Ins., Vesp., p. 86.
- Nectarinia analis* H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 230 (♀). Dalla Torre, 1894, Cat. Hym., IX, p. 169.^s
- Caba analis* R. v. Ihering, 1904, Rev. Mus. Paulista, VI, pp. 107 and 113.
- Polistes mellifica* Say, 1837, Boston Jl. Nat. Hist., I, pt. 4, p. 390 (♀ ♂; near Jalapa, Mexico); 1859, Complete Writings Entom., (Leconte's Ed.), II, p. 769 (♀ ♂).
- Nectarinia mellifica* H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 233 (♀ ♂), Pl. XXX bis (nest, described on pp. cxxix-cxxxiv). Dalla Torre, 1894, Cat. Hym., IX, p. 170. H. v. Ihering, 1896, Zoolog. Anz., XIX, p. 451; 1897, Ann. Mag. Nat. Hist., (6) XIX, p. 135. Kriechbaumer, 1900, Berlin. Ent. Zeitschr., XLV, p. 98.
- Nectarina mellifica* F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 137. W. A. Schulz, 1904, Berlin. Ent. Zeitschr., XLVIII, (1903), p. 262. H. S. Barber, 1928, Ent. News, XXXIX, p. 16.

^s Dalla Torre's reference "*Nectarinia analis* Guérin, Iconogr. règn. anim. VII. Insect. 1845 p. 148; T. 28 F. 6," is fictitious. Guérin does not mention or figure any species of *Nectarina*.

- Gaba (Nectarina) mellifica* H. S. Barber, 1905, Proc. Ent. Soc. Washington, VII, p. 25.
- Nectarina mellifera* Dalla Torre, 1904, Gen. Ins., Vesp., p. 86.
- Nectarinia binotata* H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 230 (♂; Cayenne). Dalla Torre, 1894, Cat. Hym., IX, p. 169.
- Nectarina binotata* F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 136. Dalla Torre, 1904, Gen. Ins., Vesp., p. 86.
- Caba binotata* R. v. Ihering, 1904, Rev. Mus. Paulista, VI, p. 107.
- Nectarina lecheguana* var. *binotata* R. du Buysson, 1905, Ann. Soc. Ent. France, LXXIV, pp. 547 and 563 (♂).
- Chartergus arizonaensis* Cameron, 1907, Invert. Pacifica, I, pp. 181 and 182 (♀; Nogales, Arizona).
- Chartergus centralis* Cameron, 1907, Invert. Pacifica, I, pp. 181 and 182 (♀; Chinandega, Nicaragua; and Champerico, Guatemala).
- Chartergus aztecus* Cameron, 1906, Invert. Pacifica, I, p. 154 (♀; Mexico); 1907, *Loc. cit.*, I, p. 182. Not *Nectarinia azteca* H. de Saussure, 1857.
- Nectarina cameroni* Meade-Waldo, 1911, Ann. Mag. Nat. Hist., (8) VII, p. 112. New name for *Chartergus aztecus* Cameron, 1906.
- The foregoing synonymy and references are of the typical form of the species.

Specific Characters.—*Queen and worker*.—Head of normal size and shape; seen in front, broadly oval and about as wide as high; seen from above, broadly rectangular and slightly more than twice as wide as long; occipital margin nearly straight. Carina bordering the genae not wavy, very slightly curved outward below the middle. Genae slightly wider than the eye in profile, of fairly uniform width throughout, not appreciably swollen and uniformly convex. Oculo-malar space very short, the upper mandibular condyle barely separated from the eye. Inner orbits about one and one-half times as far apart on the vertex as at the clypeus. Ocelli small, in a slightly flattened triangle; posterior ocelli about as far apart as from the inner orbits and slightly nearer the occipital margin. Eyes very distinctly pubescent; sinus broad and moderately deep. Vertex and face normal; interantennal area wide, almost flat, with the barest indication of a transverse and of an upper longitudinal ridge. Clypeus slightly and uniformly convex, broadly pentagonal, about one and one-half times as wide as long; its sides contiguous with the inner orbits over a short distance (about equal to the length of the second antennal segment); median lobe of anterior margin semi-elliptical, with

broadly rounded and blunt apex, divided by very shallow curves from the low lateral lobes. Mandibles moderately long, slightly over three times as long as wide, with subparallel sides; outer surface raised into a longitudinal convexity which runs from the upper mandibular condyle to the lower apical tooth; cutting edge very oblique, with four unequal teeth, increasing in size from the upper (or inner) to the lower one. Antennae: scape slender, slightly curved, about four and a half times as long as thick at apex and about as long as the four following segments together; second segment unusually large and swollen, nearly half the length of the third; third slightly less than the fourth and fifth together and about twice as long as wide; fourth slightly longer than wide; fifth about as long as wide; sixth to eleventh wider than long; twelfth distinctly longer than wide; flagellum very evenly swollen from the base to before the apex. Thorax as usual in the genus; carina of pronotum sharp, continuous across the middle of the anterior margin and ending at the humeral angles; humeri not prominent, not raised, placed slightly farther back than the middle of the pronotum when the thorax is seen from above. Division of the scutellum into an anterior, horizontal and a posterior, vertical area very sharp; the ridge between the two areas strong, although blunt, much protruding, nearly straight or more or less concave and sometimes slightly depressed or somewhat notched in the middle; horizontal area nearly flat, but with a conspicuous, depressed, smooth groove at the base, along the mesonotal suture; seen from above, the horizontal area is about twice as wide as long, nearly rectangular, although slightly narrower behind, ending laterally in blunt, right angles; vertical area about half the length of the anterior area, slightly concave transversely and with a fine, median, longitudinal depressed line; both the horizontal and vertical areas are abruptly divided from the somewhat concave sides, which extend to the base of the fore wing and are limited behind by a sharp carina. Median, vertical portion of post-scutellum flat, a little over three times as wide as long and nearly one and one-half times as long in the middle as the vertical area of the scutellum, distinctly shorter on the sides, where it forms at each upper angle a small, erect, blunt tooth, which is more or less strongly developed and sometimes barely indicated; the anterior margin evenly convex, the posterior margin straight; median area sharply set off from the concave sides, which extend to the base of the hind wings. Upper half of propodeum on each side with a broad, flattened, triangular ridge, quite blunt at apex, running from the spiracle to a short distance from the median concavity, forming distinct lateral

angles, which are variable in size and shape; below the angles the sides of the propodeum are evenly rounded. Second abdominal segment moderately swollen, passing by even curves into the basal slopes, seen from above slightly wider than long, in profile about as thick as long at the tergite. Integument shiny, the sculpture hidden to a large extent by the silky pubescence; punctures generally small; larger and denser on pronotum, pleura, sides of propodeum, and especially on the horizontal area of the scutellum; minute and scattered on abdomen; very sparse on clypeus and lower part of face; mandibles, vertical area of scutellum, postscutellum and concavity of propodeum impunctate. Pubescence very dense, grey, silky, especially striking in fresh specimens.

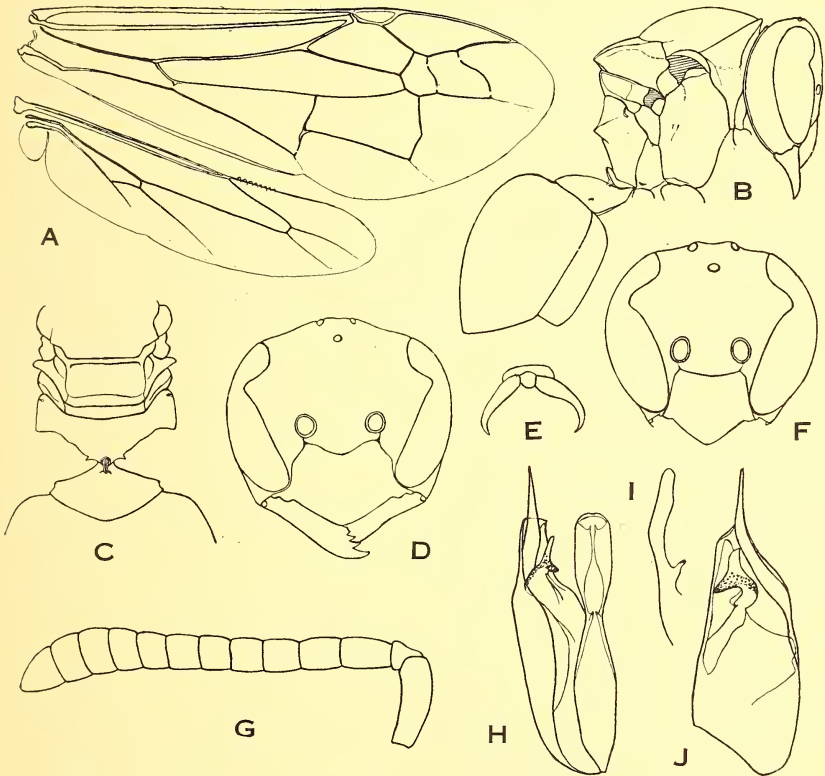


FIG. 1. *Nectarina lecheguana* (Latreille): A, wings of female; B, body of female in profile; C, scutellum, postscutellum, propodeum and base of abdomen of female from above; D, head of female; E, hind claw of female; F, head of male; G, antenna of male; H, male genitalia from above; I, penis in profile; J, right valva interna and externa from the inside.

Male.—Head somewhat flattened; seen in front, subcircular; seen from above, over three times as wide as long. Genae much narrower than in the female, about half as wide as the eye in profile. Ocelli much larger than in the female; posterior ocelli about one and one-third times as far apart as from the inner orbits, and about as far from the occipital margin as from the eyes. Eyes swollen, even more pubescent than in the female. Clypeus narrower, very slightly wider than long; its sides contiguous with the inner orbits over a long distance (about equal to the length of the third antennal segment). Antennae: scape shorter than in the female and almost straight, about two and one-half times as long as thick and slightly shorter than the three following segments together; second segment less than half the length of the third; third not quite twice as long as wide and less than one and one-half times the length of the fourth; fourth slightly longer than wide; fifth about as long as wide; sixth to twelfth wider than long; thirteenth slightly longer than wide, broadly rounded at apex; flagellum shaped about as in the female, but most of the segments bulging on the under side. Genitalia (Fig. 1H-J): stipites of valvae externae narrowed apically, the broadly truncate apex with blunt angles, the squamae long and slender, spiniform, extending much beyond the stipites; valvae internae divided into three lobes: the outermost lobe (or volsella) triangular, with blunt apex, shorter than the stipes against which it is appressed; the middle lobe (du Buysson's "tenette") large, hatchet-shaped, with two broad, blunt angles, one parallel with and about as long as the volsella, the other shorter and directed ventrad; the innermost lobe slender, finger-shaped, much shorter than the middle lobe; penis a broad rod, very obtusely rounded at the apex which is slightly curved upward; the basal convex shaft and the apical, flattened or slightly concave portion (the completely fused branches of the penis) about equally wide, but connected by a narrower neck which, on the under side, bears on each side a strong, slightly curved, blunt tooth, directed ventrad.

Length (h. + th. + t.1 + 2) of queen and worker, 7.5 to 9 mm.; of male, 7.5 to 8 mm.; length of fore wing of queen and worker, 8 mm.; of male, 7 mm.

Coloration.—*Queen and worker*.—Black. Head, thorax and legs with very few pale markings; a narrow yellow streak along the lower third of the inner orbits; middle of anterior margin of pronotum somewhat yellowish; a narrow, transverse, median yellow spot at the anterior margin of the post-scutellum. First abdominal tergite with a narrow, apical, pale yellow band; succeeding tergites and sternites with broad, pale

yellow, apical margins; sixth segment entirely yellow. Wings faintly smoky, with a strong yellowish tinge, especially marked in the anterior half of the fore wing; stigma and veins russet. Mandibles, under side of flagellum, terminal segment of tarsi, claws, and tibial spurs sometimes more or less ferruginous.

Male.—Yellow markings slightly more extensive: streaks along inner orbits reaching bottom of ocular sinus; interantennal area with two dots; anterior margin of clypeus broadly yellow; mandibles with small basal dot; under side of scape yellow; anterior margin of pronotum narrowly yellow almost to the humeri; yellow basal band of postscutellum extended to the sides. Under side of all coxae and trochanters yellow; fore and mid femora with a yellow streak on the under side. Under side of flagellum pale ferruginous throughout.

The foregoing description of the color pattern, based upon specimens from southeastern Texas, fits many of those from farther south, since variation in this species is rather limited. Frequently the yellow markings of the face and postscutellum disappear (in some, but not in all, wasps from Paraguay, Brazil, and Argentina). More rarely they may be more extensive. A few specimens have the extreme basal angles or (more rarely) the angles of the transverse ridge of the scutellum yellow.

R. du Buysson and Ducke recognize a var. *velutina* (Spinola) (= *aurulenta* Erichson), which is colored like the typical form, but is more densely covered with silky and somewhat golden pubescence. The distinction between this form and typical *lecheguana* is very slight indeed and from a study of an extensive collection, covering most of the range of the species, I feel rather inclined to suppress the variety. At any rate, all specimens I have seen from Panama and farther north belong to typical *lecheguana*.

N. lecheguana var. *borellii* Zavattari is known from a single female, from Salta, Argentina. It is entirely black, except for a narrow, yellow, apical margin of the second tergite, almost interrupted in the middle. Perhaps this was merely an aberration.

Specimens Examined from the United States.—TEXAS: Brownsville, several workers and queens (C. Schaeffer) and two males (F. E. Lutz and H. F. Schwarz); Rio Hondo, two workers. ARIZONA: Nogales, one female (Oslar; paratype of *C. arizonaensis* Cameron, at Cornell Univ.).

In Texas *N. lecheguana* occurs only in Cameron Co., where, in addition to the localities mentioned above, it was taken by Mrs. W. P. Cockerell at San Benito (Cockerell, 1927). Bradley's (1921) record from New Mexico appears to have been due to an oversight;

at any rate, I am unable to trace it either to a publication or to a specimen in a collection.

Distribution.—The range of the typical form covers most of Central and South America, from the southern border of Arizona to Buenos Aires. I have seen it from Mexico (Orizaba; Mitla; Yucatán), British Honduras, Guatemala, San Salvador, Costa Rica, Panamá (Ancon, C. Z.), Colombia, Venezuela, French Guiana, Brazil, Perú, Bolivia, Paraguay, and Argentina (Chaco de Santiago del Estero; Jujuy; Sierra de Córdoba). It is also known with certainty from Nicaragua, British Guiana, Ecuador, and Uruguay.

Ethology.—The following are, arranged chronologically, all published data referring to the nesting habits of *N. lecheguana*.⁹

Early accounts of honey-storing insects in tropical America undoubtedly refer in part to honey-wasps of the genus *Nectarina*, since these insects are often quite numerous and their nests more conspicuous than those of the native, stingless honey-bees (Meliponidae).¹⁰ Thus G. Pison (1648, *De Medicina Brasiliensi Libri IV*, p. 56) mentions the "bees" called "*eixy*" and "*copij*" in Brazil, which produce small quantities of excellent honey, yet neglected by the natives owing to the fierce sting of the insects. G. Maregravius de Liebstad (1648, *Historiae Rerum Naturalium Brasiliae Libri VIII*, p. 259) reports some observations on "bees" made by one Jacobus Rabbi, who lived many years among the Tapuya Indians of Brazil. Several of the insects mentioned are wasps, since they are said to build nests of paper and to sting "even so as European bees."¹¹ In a later work, Pison (1658, *De India*

⁹ This detailed digest of the literature is offered for a twofold purpose. It is, of course, important to focus attention upon the many gaps left in the history of the honey-wasps. On the other hand, I wish to emphasize that the habits of the Vespidae have not by any means been neglected to the extent some critics of modern Entomology would make us believe. It is customary for many latter-day "ecologists" to ignore the ethological data contained in taxonomic publications. Perhaps it is better so, since a narrow-minded contempt for taxonomic niceties renders these "biologists" singularly unfit for the task of properly correlating published observations on the habits of insects.

¹⁰ Latreille [1809, *Recueil d'Observations de Zoologie*, of Humboldt and Bonpland, I (1st Ed.); I have consulted the 2d Edition, pp. 268-276, published in 1812] gives a good résumé of the older accounts of American honey-storing insects.

¹¹ The insect called "*kitshaara*," which hangs its nests in low trees, living "in alveolis dimidiam ulnam longis, instar chartae

Utriusque Re Naturali et Medica Libri XIV, pp. 111–113 and 287–288) repeats most of his former statements, but he adds a description and figure of an arboreal honey-storing wasp, recognized as such, evidently one of the color forms of *Polybia occidentalis*.¹²

Francisco Hernández (1651, *Rerum Medicarum Novae Hispaniae Thesaurus seu Plantarum Animalium Mineralium Mexicanorum Historia*; Lib. IX, p. 133) mentions several kinds of honey-storing bees and wasps of Mexico and even figures two of the nests. His figure labelled “*yzaxalasmittl*” is certainly the vesparium of *Nectarina lecheguana*, as recognized by H. de Saussure (1857–1858, *Et. Fam. Vesp.*, II, Introduction, p. cxxxiv), and is the earliest known figure of a nest referable without a doubt to this wasp.¹³

All of the preceding accounts are very vague and most of them are unsatisfactory for positive identification. The celebrated traveler, Felix de Azara (1809),¹⁴ however, gave much more definite information. He pointed out that the natives of Paraguay differentiated between honey-storing bees and wasps, the former being stingless and producing wax, the latter stinging and making no wax. Moreover, he clearly recognized two different species of honey-storing social wasps, known by the Guarani Indians as “*chiguana*” and

bibulae formatis,” and storing excellent and very fragrant honey, may have been one of the forms of *Polybia occidentalis* (Olivier). The names “*kitshagk*” and “*heubig*,” applied to subterranean builders, may refer to *Polybia nigra* H. de Saussure (*P. atra* of de Saussure and most authors, but not *Vespa atra* Olivier), which usually nests underground and stores much honey. The honey called “*atshoy*” is also produced by a stinging wasp, living in arboreal, hard and black nests, possibly *Nectarina lecheguana*.

¹² “*Nidus minorum Vesparum (cujus iconem exhibeo) est plus quam majoris ovi oloris magnitudinis et formae, sed levissimi ponderis. Exterius obductus villosa, tenui et tenaci materia grisei coloris, qua avulsa apparent tres quatuorve tabulae parietibus distinctae, ex meris cellulis rotundis egregie fabricatae, et more parvi apiarii concinnatae. Quibus reconditum melligineum humorem haud facile quisquam impune attingit, quia Crabrones vix patiuntur se irritariet.*”

¹³ Hernández’ figure was copied by Latreille (1809, *Recueil d’Observations, etc.*, Humboldt and Bonpland, I, 1st Ed., Pl. XXI, fig. 4).

¹⁴ *Voyages dans l’Amérique Méridionale. Publiés d’après les Manuscrits de l’Auteur par C. A. Walckenaer.* (Paris). 4 vols. and Atlas. The passage referring to honey-storing wasps is in vol. I, pp. 165–172 (“*chiguana*” and “*canuatý*,” pp. 171–172).

“*camuatý*” respectively. The first name is even nowadays used in Paraguay and neighboring regions for *Nectarina lecheguana*, while the second is applied to *Polybia occidentalis* var. *scutellaris* (White). F. de Azara also called attention to the differences in the aspect and location of the nests of these two wasps; unfortunately, as recognized by Brèthes (1903, An. Mus. Nac. Buenos Aires, (3) I, p. 415), he transposed the native names, so that the nest which he credits to the “*camuatý*” is really that of *N. lecheguana*.

In his memoir on the South American bees, published in 1809 (1st Ed.) and 1812 (2d Ed.), Latreille refused to admit that any true wasps could store honey. He referred to the Meliponidae, or stingless bees, all previous accounts by Hernández, Pison, Marcgravius and de Azara of honey-storing insects in tropical America. A few years later (1824), however, he was forced to recant, when Auguste de Saint-Hilaire brought from southern Brazil specimens of the “*lechiguana*” wasp, together with some of the honey it stores¹⁵ and portions of the paper combs. A. de Saint-Hilaire [1822, Mém. Mus. Hist. Nat., Paris, IX, p. 373; and 1825, *Ibidem*, XII, pp. 296–306; see also his *Voyage dans les Provinces de Rio de Janeiro et de Minas Geraes*, (Paris), 1830.]¹⁶ narrates at length how he was poisoned by eating honey gathered from a nest of *N. lecheguana*. The nest was nearly oval, about the size of a man’s head, built of a gray chartaceous material like the *vesparia* of Europe, hanging from the branches of a bush about a foot above the ground. The inhabitants of that part of South America are perfectly aware that the honey stored by this wasp may sometimes be poisonous, and they even claim to know the plant from which the poisonous honey is gathered.

Thomas Say (1837) concludes the description of his *Polistes mellifica* with the statement that “near Jalapa [Mexico], my attention was attracted by a group of Indians, who were eating honey from a paper nest, which was then so far dissected in their repast, that I could not ascertain its proper form. The honey had a pleasant taste, and so far as I could gather from their gestures, the nest was obtained from a tree.”

¹⁵ Lassaigue (1824, Mém. Mus. Hist. Nat., Paris, XI, pp. 319–320) published an analysis of this honey.

¹⁶ Mr. Herbert F. Schwarz calls my attention to a footnote on p. 375 of vol. II of this work, in which de Saint-Hilaire doubts that the Brazilians would call *N. lecheguana* “*abelha*.” However, this would be no stranger than the vernacular name “Mexican bee” given to this wasp in southeastern Texas.

Some of the accounts of exploration and travel in South America contain occasional references to honey-storing insects, but in most cases it is impossible to refer them to either bees or wasps. R. Schomburgk's (1848, *Reisen in Britisch Guiana*, II, p. 104) description of a paper nest made by a stinging "bee" in a tree, looking much like that of *Vespa* and containing very sweet honey, probably refers to *N. lecheguana* var. *velutina* (Spinola). That wasp was described by Erichson, as *Brachygastra aurulenta* (1848, *Ibid.*, III, p. 590), from specimens collected by Schomburgk during his journey.

To H. de Saussure (1853-1858, *Et. Fam. Vesp.*, II) we owe the first adequate descriptions and figures of the nests of *Nectarina*. His Pl. XXX reproduces a photograph of a nest of unknown origin, which he refers to *N. lecheguana* in the Explanation of the Plate, although in the Introduction (p. cxxxiv) he says that he does not know for certain which species built the nest. This figure shows quite well how a new comb is started by the wasps building cells on to the outer cover or envelope of the nest; the new cells at first form irregular, unconnected patches, each patch, when completed, being covered with its own paper envelope; eventually all the patches fuse and the one resulting comb is enclosed by one single, continuous envelope. The whole nest is nearly spherical, a little over one foot in diameter, fixed to a branch running through the whole nest. H. de Saussure's detailed description of the inner structure is based upon nests which he studied in Mexico, a cross-section of one of them being shown in his Pl. XXX *bis*.¹⁷ Outside, the nests resemble those of *Vespula*, being likewise irregularly sub-spherical and built of similar gray paper, but thinner; the outer envelope, however, is a single, rather irregular sheet of paper (in *Vespula* it consists of several concentric sheets or of many imbricated scales). The single or double entrance at the lower end is rather wide and slit-like. On a cross-section, the nest is seen attached to branches about which it forms a number of strongly con-

¹⁷ In the Explanation of this Plate the nest is referred to *N. mellifica*, although according to the Text of vol. II (p. 233) H. de Saussure had not recognized this species. The seeming contradiction is explained by the fact that the taxonomic part (pp. 1-256) and most of the Plates of the second volume of de Saussure's 'Etudes' were published in 1853-1855, while the Introduction (pp. i-cc) and some of the plates were issued in 1857-1858, after the author's return from Mexico. R. du Buysson says that the nests figured by de Saussure are yet extant at the Paris Museum.

vex and more or less concentric combs, the size of the combs and the number of cells increasing from the first or innermost to the last or peripheral comb. At the same time the successive combs become less convex, the inner ones being more nearly spherical, the outer ones more cap-shaped. To pass from one tier to another the wasps use one or more spiral ramps or corridors: each comb is pierced with one or more holes and connected at each hole with the combs above and below it by means of plates (covered with cells on the under side), the successive plates being arranged so as to form a spiral ramp. H. de Saussure found as many as five of these ramps in a single nest, but most of them ran only through some of the combs; only two of them ran throughout the structure, ending below in an entrance to the nest. The ramps not only help the movements of the wasps within the nest, but add to the strength of the structure, which is, moreover, well supported by the many branches that cross it in every direction. The peculiar manner in which the nest grows, by addition of a new comb in patches on to the outside cover, has been described above. As de Saussure justly points out, the nests of *Nectarina* are among the most remarkable built by any wasps (or any insects, for that matter). They manage to contain the largest number of cells within the smallest space, providing at the same time for a maximum of solidity and comfort and a minimum of labor and material. Although they are not the largest structures built by wasps, since they do not exceed two feet in diameter, they are certainly the most populous.

K. Möbius' (1856; as *Chartergus sericeus*) descriptions and figures of two nests from Puerto Cabello, Venezuela, agree in the main with those given by de Saussure. Both nests were subglobular, the larger being 50 cm. across and containing approximately 60,000 cells, each cell 6 to 7 mm. deep and 4 to 5 mm. wide. The combs were placed about 10 mm. apart. There were several entrances to the nests. While the outer envelope was of fibrous plant material, the walls of the cells were built mostly of hair cells. Möbius found that the full-grown larva spins over the top of the cell a grayish white, convex cap, 4 to 5 mm. high.

F. Smith (1863) discusses the true significance of honey-storing habits in some South American wasps. He writes: "When a wasp's nest is discovered, in which the combs are constructed of a material adapted for containing honey,¹⁸ and in which young brood

¹⁸ In preceding paragraphs of the same paper Smith argues that papery or carton cells are not suitable as honey containers, like the waxen cells of the social Apoidea.

is also found, showing this habit to form a part of the usual economy of the species, then we shall have some legitimate grounds for believing in the existence of certain species of wasps being, in the true signification of the term, honey collectors. At present, it appears to me, that we only know as a fact, that certain wasp-nests occasionally contain honey, supposed to have been stored by the wasps themselves; they, in the first place, not having constructed their cells of a material adopted for containing it. The nests of *Nectarina analis*, and also of *N. lecheguana*, are all constructed of papyraceous materials, but of a somewhat firmer texture than those of *Polybia*. All the species of *Nectarina* are said to be honey collectors; if such be the case, may it not be possible that it is stored up at a period when the rearing of brood is suspended, and when they are prevented from collecting food abroad, the honey forming their support during such a season; or is it simply to be regarded as booty obtained by the plunder of nests of honey-collecting bees, and that deserted wasps' nests are merely used as temporary receptacles." This passage calls for the following remarks. There is absolutely no reason to doubt that *N. lecheguana* collects directly from flowers the honey it stores in the nest, and this wasp has never been observed robbing bees' nests. Moreover, the paper combs of *Nectarina* form excellent containers for honey under natural conditions, even though the cells filled with honey are never capped over. Smith was deceived by the appearance of nests that had undergone the many hazards of a long journey to Europe. It must, however, be recognized that we do not yet know, from direct observation, what use the wasps make of the stored honey, whether it is ever fed to the brood or serves only as sustenance to the adults during times of distress.

In a suggestive paper "On the Construction of Hexagonal Cells by Bees and Wasps," F. Smith (1864) defends the theory that the hexagonal structure of the combs is due not merely to the reciprocal adjustment of cells arising from consecutively constructed hemispherical bases, but that wasps and bees commence the combs "with the intent instinctively to build hexagonal cells." In support of this view he calls attention to a nest of *N. lecheguana*. "The nest of this wasp," he says, "is of globular shape, and is sometimes not less than 16 or 18 inches in diameter; the foundation is a single comb, enclosed in a globular envelope; on this envelope the wasps commence series of cells on all sides; these cells are covered in patches by envelopes, the envelope always serving as the foundation of a fresh series of cells: a repetition of the above proc-

ess, on all sides of the continually increasing nest, results in structures such as I have described. Now you will observe, that all the cells constructed by these wasps are built upon the flat outer envelopes, and if you examine the specimens exhibited, you will see, in some instances, the faintest ground-plan of the hexagonal cell intended to be raised, traced on the flat foundation." Smith might have added, as further proof that these wasps intentionally build hexagonal cells, that, when the several patches of cells, started at various spots of the outer envelope, eventually come together, much skillful readjustment of cells is called for in order to produce a single comb of perfectly hexagonal cells. Social wasps seem therefore to be endowed with a certain amount of geometrical sense, as well as with the ability for concerted teamwork. Their activities can hardly be explained wholly in terms of rigid, stereotyped instinctive behavior or reflexes, even though their solitary ancestors may have started with a simpler, more fortuitous architecture.

According to H. von Ihering (1896), the colonies of *Nectarina* are perennial and are started by swarms from some older colony. He noted that the vesparia of *N. lecheguana* (as *N. mellifica*), in southern Brazil, are usually placed rather low and are very rich in honey. They often are preyed upon by the lizard, *Tupinambis teguixin* (Linnaeus). He observed one of the nests that, in the fall, contained about as many males as workers. The latter contained for the most part eggs; but, owing to the rudimentary receptaculum seminis (or spermatheca) he regarded them as workers. He suspects that in this wasp also the eggs laid by workers produce males, which would explain the exceptionally large number of males. His son, Rud. von Ihering (1904), described a nest, from the State of São Paulo, consisting of about 20 combs and measuring 27 by 39 cm.; it had several entrances.

R. du Buysson (1905) records many interesting observations made by L. Digue, in Mexico, and E. R. Wagner, in Argentina. The vesparia of *N. lecheguana* are perennial, lasting for several years, and each contain several fertile, ovipositing females. Digue brought from Mexico the major part of a colony, preserved in alcohol, of which one-sixth about were large queens with free eggs in the oviducts, ready to be laid. In the spring one finds very small nests, evidently started by swarms of several fertile queens and a few workers. The egg is placed in or near the bottom of the cell. R. du Buysson also gives a detailed description and a figure of the full-grown larva, which is so large that it protrudes for about one-third of the length beyond the rim of the cell. In

Mexico the honey of these wasps is highly prized by the Indians, who do not regard the insects as very aggressive. In Jalisco the honey is gathered every year in December, the wasps being readily chased from the nest by smoke; the nest is then broken off, the basal comb being left on the bush, because, it is said, the old colony then promptly rebuilds on the same spot. Wasp honey is often sold in the market. It is very limpid and strongly scented, but crystallizes more rapidly than bees' honey. Sometimes, when the *Daturas* are in bloom, the honey may be toxic, and cases of poisoning are not rare. Some of the Indians also raise the nests, cutting them when they are small and carrying them, tied in cloth, to their gardens. R. du Buysson's Plates XV and XVI are photographs made in Oaxaca from a nest that had been kept in a garden for a year only, where it had grown from a sphere 10 cm. across to a more irregular vesparium, 34 cm. by 29 cm.¹⁹ In northern Mexico and in northern Argentina, *N. lecheguana* withstands rather low temperatures and even slight frosts (-5° C.); the adults then hibernate hidden in the cells, from which only the tip of the abdomen protrudes. R. du Buysson assumes that the larvae are fed honey and balls made by the workers chewing up tender insect larvae. Yet he states that, after examining several nests, he never found in them chitinous insect remains or mutilated prey, such as are easily seen in the closed vesparia of *Vespa* and *Polybia*. As I have pointed out before, the actual food and manner of feeding of the larvae have not yet been observed in nature.²⁰

The few observations made on *N. lecheguana* near Brownsville, Texas, may conveniently be grouped together. H. S. Barber (1905), who seems to have observed them first in that region, exhibited a photograph of a nest at a meeting of the Entomological Society of Washington. The nest, he stated, was similar to that of *Vespa maculata*, except that in its lower portion the cells were exposed. It was globular in shape and about 9 inches in diameter. The wasp was said to produce a palatable honey. F. C. Pellett (1922) reports some observations made by beekeepers of the Lower Rio Grande Valley, who stated that the wasps stored honey and swarmed like bees. "When they sting they lose their stings as do

¹⁹ These photographs are reproduced by H. F. Schwarz (1929).

²⁰ In this connection it may be mentioned that the adults of many social wasps of South America steal meat or dead fish exposed to the sun. This habit is recorded for *Nectarina augusti* by Bertoni (1911, An. Mus. Nac. Buenos Aires, (3) XV, p. 114), so that *N. lecheguana* might be expected to do likewise.

the honeybees." A nest, shipped to Hamilton, Illinois, was kept with a living colony throughout the summer; but the wasps all died the following winter. Herbert F. Schwarz (1928 and 1929) published a most interesting study of the habits of this wasp, locally known as the "Mexican bee," because of the partiality of the Mexicans for the honey it produces. He noted that the insect is rather unaggressive, even when a colony is disturbed, although it is quite able to sting and then leaves the sting in the wound. The after-effects of the sting may be quite severe. One of the two nests found in January contained neither larvae nor honey, though there was a strong smell of honey in the combs; some 15,000 wasps were collected from that nest, one in every fifteen being a male. Some days later a number of the wasps were caught visiting flowers, so that even in the region of Brownsville they are not completely dormant throughout the winter. The two photographs, reproduced on Plates XXVII and XXVIII, represent a nest taken by Mr. Herbert F. Schwartz and Dr. F. E. Lutz at Brownsville and now preserved at the American Museum of Natural History.

Sources of Honey.—Although the species of *Nectarina* are very active gatherers of honey, their mouth-parts show apparently no departure from those of most other social and solitary Vespidae that only casually imbibe flower secretions. The tongue and maxillae are very short and broad and differ only in minor details from those of *Vespa*.²¹ One might therefore expect that *N. lecheguana* will gather nectar on many different kinds of flowers and will show no decided preference for any particular floral type. Owing to its small size, it is able to tap not only flowers with freely or shallowly exposed nectar, but even some where the nectar is deeply hidden. The rather scanty published data and my own observations in Yucatán and Guatemala fully support these conclusions. Duke (1904, Bol. Mus. Goeldi, Pará, IV, p. 319) lists some of the plants that are visited by social wasps near Pará, Brazil, but does not state which of them were observed being visited by *Nectarina* (as R. du Buysson claims). According to R. du Buysson (1905), L. Diguët saw *N. lecheguana*, in Mexico, preferably at flowers of peach-trees, mango-trees and large Compositae. Mrs. W. P. Cockerell collected this wasp at San Benito, Texas, visiting flowers of

²¹ Compare, for instance, du Buysson's figures of the mouth-parts of *N. lecheguana* (1905, Ann. Soc. Ent. France, LXXIV, Pl. XII, figs. 1-3) with those of *Vespula vulgaris* (1903, *Loc. cit.*, LXXII, Pl. III, figs. 1-4). In both *Vespula* and *Nectarina*, the maxilla bears on the inner side a well-developed comb of stiff setae.

Koeberlinia spinosa Zuccarini (Cockerell, 1927). Schrottky (1908), in Paraguay, lists it among the visitors of two introduced plants, *Delphinium Ajacis* Linné and *Oxalis* sp.

In Yucatán (region of Chichen Itzá, May to July, 1929) I observed *N. lecheguana* at the flowers of *Acacia Collinsii* Safford, *A. Gaumeri* Blake, *A. riparioides* (Britton and Rose), *Melampodium divaricatum* (L. Richard), *Eupatorium albicaule* Schultz Bip., *Calliandra acuminata* Humboldt, Bonpland and Kunth, *Ehretia tinifolia* Linné, *Boerhaavia erecta* Linné, *Croton fragilis* Humboldt, Bonpland and Kunth, and *Achyranthes aspera* Linné. In Guatemala (in the coffee-growing district at Mocá near Guatalón and near Pochuta, February to May, 1931) it was taken at *Acacia Hindsii* Bentham, *Baccharis trinervis* Persoon, *Borreria suaveolens* Meyer, *Sclerocarpus divaricatus* (Bentham), *Euphorbia heterophylla* Linné, *Melampodium divaricatum* (L. Richard), and *Eupatorium morifolium* Miller; and it was one of the most common visitors of the flowers of the mango-tree (*Mangifera indica*).

T. Belt (1874, *The Naturalist in Nicaragua*, p. 228) noted, in Nicaragua, that the wasps of the genus *Nectarina* visit frog-hoppers for the sake of the sweet exudations of these insects.

N. lecheguana is often seen sucking moisture on wet sand or at the edge of water (Schrottky, 1909, and personal observations in Yucatán and Guatemala). According to E. R. Wagner (in R. du Buysson, 1905), after drinking the wasp rises a little and then flies in a direct, horizontal line toward the nest on to which it suddenly drops. The natives of northern Argentina are aware of this behavior and they follow the flight-line of the wasps on horse-back, in order to find the nest.

Homeomorphy and Homeochromy with Other Insects.—In Central and South America, *Nectarina lecheguana* is one of the most abundant members of a group of insects (mainly Hymenoptera) which, through parallel variation combined with regional convergence, have assumed a most deceptive resemblance in general shape and color pattern. This group of so-called "mimics" includes the following genera and species, at present known to me; but no doubt the list could be considerably extended.²²

²² In order to escape the theoretical implications unavoidably connected with the terms "mimic" and "mimicry," I intend to use in the future the neutral terms *homeomorphic*, *homeomorphy*, *homeochromic* and *homeochromy*, for superficial resemblances in shape or color among different species of arthropods. These terms group the facts without alluding to their possible interpretation or origin.

Hymenoptera. Eumeninae: *Pachodynerus nasidens* (Latreille); *P. brevithorax* (H. de Saussure); *P. argentinus* (H. de Saussure); *Odynerus similis* Smith; *O. peyroti* H. de Saussure; *O. otomitus* H. de Saussure; *O. cordovae* H. de Saussure; *Ancistrocerus parredes* (H. de Saussure); *A. arista* (H. de Saussure). Sphegoidea: *Gorytes similicolor* R. Dow (of Paraguay); *Cerceris maximiliani* de Saussure (of British Honduras and Yucatán; det. R. Dow). Apoidea: *Megachile aurantipennis* Cockerell; *M. microsoma* Cockerell; *M. pulchriventris* Cockerell; *Anthidiellum auricolle* (Friese); *A. apicale* (Cresson); *Hypanthidium taboganum* Cockerell; *Dianthidium nectarinioides* Schrottky; *D. manni* Cockerell; *D. holmbergi* Cockerell;²³ *Epeolus fulvopilosus* Cameron (which plaits the fore wings longitudinally at rest); *E. xanthurus* Cockerell; *E. cameroni* Meade-Waldo; *Trigona postica* (Latreille);²⁴ *Stelis costaricensis* Friese; *Halictus sericeus* Friese. Chalcidoidea: an undetermined species of Chalcidinae, which I have taken in Guatemala.—Diptera. Stratiomyidae: *Stratiomys mutabilis* (Fabricius).

Of the insects listed above, *Pachodynerus nasidens* (Syn.: *Odynerus cariniscutis* Cameron) is the only species found thus far in southern Arizona and Texas together with *N. lecheguana*.²⁵

²³ In describing these and some other related Anthidiinae, Cockerell (1927, Proc. U. S. Nat. Mus. LXXI, Art. 12, p. 2) writes: "The whole series of Bolivian *Dianthidium* now before me may apparently be referred to *Anthodiocetes*, which may be regarded as a subgenus. These bees, with certain species of *Psaenythia* (as *P. collaris* Schrottky and *P. facialis* Gerstaecker) and the wasps of the genus *Nectarinia* appear to constitute a case of Müllerian mimicry." Cockerell also describes *Anthidium beniense*, in which, he says, "the wings fold longitudinally after the manner of *Nectarinia*." Of the several Anthidiine bees recorded by Cockerell, only *D. manni* and *D. holmbergi* appear to be homeochromic with *N. lecheguana*; the remainder seem to resemble rather other species of *Nectarinia*.

²⁴ A worker of *T. postica* was kindly sent to me by Mr. Herbert F. Schwarz. It offers in my opinion as good a superficial resemblance to *N. lecheguana* as any of the other bees of my list, although Mr. Schwarz did not regard the resemblance as striking. Moreover, Mr. Schwarz added in his letter: "With this specimen I am enclosing a few other closely related insects (of the genus *Trigona*) which depart still further from the appearance of *Nectarina* and suggest that such resemblance as *postica* bears to *Nectarina* is probably merely a chance resemblance."

²⁵ I have seen *P. nasidens* from Palmerlee, Ariz.; Dragoon, Cochise Co., Ariz.; and Brownsville, Texas.

The *N. lecheguana* color group is only one of many homeo-chromic groups of South American insects. Most of these groups center about one or more species of social Vespidae, and include, together with a few insects protected by stings, others that are apparently defenceless. Each group then is a mixture of insects with "warning colors" (Poulton's synaposematic mimicry) and others with "deceitful colors" (Poulton's pseudaposematic mimicry). Whether or not these groups are examples of true mimicry, effectively protecting, at least to some extent, their members against potential enemies, is open to question. It is even more debatable whether these several groups, comprising together many hundreds of species of insects, could have been produced by the mere chance working of Natural Selection upon the ordinary fluctuating variations of their ancestors. In a discussion of the two distinct problems of the actual meaning and the possible origin of deceptive resemblance, many points should be carefully considered, some of which are overlooked or underrated by the mimicry enthusiasts. It is, for instance, rather baffling that in the case of the color group centering about *N. lecheguana*, some of the members cover a very wide territory, being found alone in certain areas. This is notably the case for *Pachodynerus nasidens*, an extremely "pushing" wasp that thrives perfectly and even invades new territory in the absence of any of its so-called "mimics," which are supposed to help it by "warning" its enemies. *P. nasidens* is the only member of this color group known from the Antilles and in recent years it has become extremely abundant in the Hawaiian Islands, having been accidentally introduced there by man. Its rapid invasion of the Hawaiian Islands is the more remarkable, since that Archipelago has its own peculiar groups of Eumeninae (of totally different color patterns). According to the theory, *P. nasidens* would be particularly handicapped there in attempting to escape the predacious enemies that had not "learned" to recognize its pattern. If *P. nasidens* needs no "synaposematic" protection in Hawaii, why should it and other similarly colored wasps be helped by such protection in America?

Enemies and Parasites.—Among the arthropod enemies of *N. lecheguana* may be mentioned certain asilids. At Chichen Itzá, Yucatán, I caught a female *Promachina trapezoidalis* (Rondani) (named by S. W. Bromley) devouring a worker of this wasp. I have quoted above H. von Ihering's observation of the lizard, *Tupinambis teguixin* (Linnaeus), feeding upon these wasps in southern Brazil. Probably some birds also attack them or their nests. We

are, however, woefully ignorant of the feeding habits of Neotropical birds. Prince Maximilian of Wied (1830, Beiträge zur Naturgeschichte von Brasilien, III, Abt. 1, p. 159) states that the red-throated caracara, *Ibycter americanus* Boddaert (*Falco nudicollis* Daudin), of the forests of southern Brazil, lives to a large extent on bees and wasps of unknown species ("Marimbondos"), of which it even attacks the nests. He found several times the stomach of this bird filled with wasps.

Salt and Bequaert (1929) saw a female of *N. lecheguana*, from Tacna, Rio Putumayo, Perú, bearing a female Strepsipteron under the fifth tergite. No other parasites are at present known.

Mischocyttarus H. de Saussure

Mischocyttarus H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 19 (for two species: *Zethus labiatus* Fabricius, 1804, and *Mischocyttarus smithii* H. de Saussure, 1853-1855; type by designation of Ashmead, 1902, Canad. Entom., XXXIV, p. 166: *Zethus labiatus* Fabricius, 1804).

Mischocyttarus H. de Saussure, 1852, Et. Fam. Vesp., I, Introd., p. viii, footnote, without description or species; *nomen nudum*).

Polybia subg. *Polybia* div. *Kappa* H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 200 (for eight species; *Polybia injucunda* H. de Saussure, 1853-1855, the first species, is herewith designated as the type).

Polybia subg. *Polybia* div. *Omega* H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 206 (monotypic for *Polybia filiformis* H. de Saussure, 1853-1855).

Megacanthopus Ducke, 1904, Bol. Mus. Paraense, IV, pp. 320 and 358 (for nine species; *Megacanthopus collaris* Ducke, 1904, the second species, is herewith designated as the type).

Monacanthocnemis Ducke, 1905, Rev. d'Ent., Caen, XXIV, p. 21 (monotypic for *Polybia filiformis* H. de Saussure, 1853-1855).

Pseudopolybia H. v. Ihering, 1896, Zoolog. Anz., XIX, p. 452 (by inference for *Polybia vicina* H. de Saussure, 1853-1855, and *Polistes ignobilis* Haliday, 1836; type by present designation: *Polistes ignobilis* Haliday, 1836 = *Vespa atra* Olivier, 1791). Not *Pseudopolybia* H. de Saussure, 1863.

Generic Characters.—Body elongate, slender. Head broad and short; eyes bare; ocelli normal; oculo-malar space well-developed but short, sometimes very short; genae broad, not separated by a carina from the postgenae; vertex also rounded off into the occiput; clypeus short, its lower portion broadly triangular and bluntly rounded off or more or less pointed at

apex; mandibles moderately broad, the apical or cutting edge slightly oblique and with three subequal lower teeth, the fourth, upper tooth smaller; maxillary palpi 6-jointed; labial palpi 4-jointed, the apical segment without erect inner seta. Antennae of 12 segments in female and worker; of 13 segments in male, the flagellum being either of normal shape or with some of the segments modified in various ways and then often curled up. Thorax usually elongate and slender, always longer than wide or thick; anterior margin of pronotum truncate, dorsally with or without rim, the humeri angular or rounded off; mesonotum without notauli; scutellum large, rectangular, cushion-shaped, uniformly but slightly convex; postscutellum (true metanotum) transverse, slightly convex, separated from the propodeum by a deep, straight suture; propodeum more or less elongate, with flattened sides, its median portion oblique and more or less concave, without even a trace of median basal area; scutellum, postscutellum and propodeum forming a continuous slope; valvae surrounding the retractor muscle low, forming a broadly oval or elliptical dorsal orifice; mesopleura divided by a distinct mesepisternal suture into an upper and a lower plate, without epinemial suture; mesepimeral suture well developed. Abdomen as a rule long and slender, the posterior segments little or hardly retractile within the second; first tergite long, much narrower than the second, always stalk-like and sometimes with a narrower basal portion. Legs long; coxae larger than usual; third and fourth segments of mid and hind tarsi asymmetrical, the inner apical lobe produced and decidedly longer than the outer lobe (the difference as a rule more pronounced on the fourth segment); claws of mid and hind legs more or less asymmetrical, often strongly so; mid tibiae with two apical spurs (except in the subgenus *Monacanthocnemis*). Wing venation of the usual vespid type; fore wing with the basal vein ending a short distance from the stigma; radial cell long, but only slightly narrowed apically; hind wing with a long and narrow basal (or posterior) lobe, the preaxillary excision rudimentary or absent. The males differ from the queens and workers mainly in the flattened face and the shape of the clypeus which is more truncate anteriorly. Queens and workers are structurally alike and are difficult to distinguish even by size.

Taxonomy.—As defined above, *Mischocyttarus* includes, not only the few larger species related to the genotype, but also the more numerous smaller forms which Ducke at one time separated under *Megacanthopus*. The latter he originally (1904, p. 358) defined as follows: "Ocelli et clypeus normales. Marium antennae (an in

speciebus omnibus?) ad apicem involutae, articulo ultimo acuminato vel compresso-dilatato. Scutellum plus minusve convexum, post-scutellum et segmentum medianum plus minusve obliqua. Abdomen longe petiolatum, petiolo apicem versus nunquam repentine incrassato, sed plus minusve gradualiter dilatato. Pedes intermedi et postici tarsorum articulis 3° et praecipue 4° lobo interno in spinam longissimam producto." None of these characters are really diagnostic, since they are present in the genotype of *Mischocyttarus* as well. Ducke, however, in the key to the genera proposed the following distinction (1904, p. 320) :

Corpus compressum, valde elongatum. Abdominis segmentum 1^{um} thorace haud brevius. Ocelli in triangulo distincte altiore quam lato. Longitudo corporis 18 mm. haud inferior :

Mischocyttarus.

Abdomen depressum, plus minusve ovale; si petiolus thoraci longitudine aequalis vel superior est, corporis longitudo est 18 mm. multo inferior. Ocelli in triangulo aequalato vel altitudine latiore:*Megacanthopus*.

These characters, again, do not allow of any clear-cut distinction. Among the species placed by Ducke in *Megacanthopus* one finds every passage from compressed to depressed bodies, as well as from long to short petioles. *M. flavitarsis* is about as large as *M. labiatus* and one finds every gradation in size, evidently regardless of relationship. The shape of the ocellar triangle, likewise, is unreliable; for instance, I am unable to discover any appreciable difference in this respect between *M. labiatus* and *M. flavitarsis* or *M. carbonarius* (de Saussure).

Monacanthocnemis was separated by Ducke (1905) from *Megacanthopus* and *Mischocyttarus*, owing to the presence of one spur only at the apex of the mid tibia. Originally it was monotypic; but later (1906, Rev. d'Ent., Caen, XXV, p. 9), Ducke also referred to it his *M. buyssoni*. Apart from the character of the tibial spur (which is exceptional in social wasps), both *M. filiformis* and *M. buyssoni* are typical *Mischocyttarus*. In this case, as in that of *Zethus*, the number of tibial spurs seems to vary regardless of true relationship.

In his more recent papers, Ducke recognized that *Megacanthopus* and *Monacanthocnemis* could at the most claim subgeneric rank (1914, Zool. Jahrb., Abt. Syst., XXXVI, p. 317), and in his recent Catalogue of the Social Wasps of Brazil (1918, Rev. Mus. Paulista, X, pp. 368-369) he points out that these two groups exhibit no ethological differences from *Mischocyttarus*.

Mischocyttarus thus becomes a very extensive genus and it is at present difficult to get a correct idea of the number of species it contains. Ducke (1918) recognizes 22 valid species from Brazil alone, and one more has been described since. To these should be added at least 6 from North and Central America and the West Indies. There are probably in all some 30 to 35 valid species known.

In order to indicate the relationships of the two species found in the United States, I have added all the West Indian forms to the subjoined key.

KEY TO NEARCTIC AND WEST INDIAN SPECIES

1. Large species: fore wing 12 to 18 mm. long. Oculo-malar space short; in female and worker about the length of the eighth antennal segment. Head swollen; genae about as wide as the eye in profile. Anterior margin of pronotum very slightly raised; its humeral angles rounded, not projecting. Claws of mid and hind legs about equally thick in each pair, but one of them slightly longer. First abdominal segment long but rather thick, about one and one-third times as long as the second tergite. Male: antennae curled up, all the segments of the flagellum much longer than wide, the last one very slender; clypeus subrectangular, its lateral margins broadly separated from the eyes. Species of Western North America. *M. flavitarsis* (H. de Saussure).
- Much smaller species: fore wing 7.5 to 11 mm. long. Male (as far as known): antennae normal, most of the segments of the flagellum as wide as or wider than long (except the basal 2 or 3), the last short and conical; clypeus transversely pentagonal, its lateral margins touching the eyes over a long distance. 2.
2. Claws of mid and hind legs strongly asymmetrical, one of the claws in each pair being much longer and thicker than the other. Head of normal shape; genae narrower than the eye. Oculo-malar space very short; in female and worker much less than the length of the eighth antennal segment. Anterior margin of pronotum much raised, with distinctly projecting, obtuse humeral angles. First abdominal segment long and slender, at least one and one-third times as long as the second tergite. Southeastern United States, Cuba, Jamaica, Mexico, Central America *M. cubensis* (H. de Saussure).
- Claws of mid and hind legs almost equally thick in each pair, but one of them slightly longer 3.

3. Oculo-malar space very short; in female and worker much less than the length of the eighth antennal segment. Head moderately swollen; genae narrower than the eye. Anterior margin of pronotum distinctly raised; humeral angles slightly projecting. First abdominal segment long and slender, one and one-third times as long as the second tergite. Santo Domingo, Porto Rico, Virgin Islands.

M. phthisicus (Fabricius).

- Oculo-malar space long; in female and worker over the length of the eighth antennal segment. Head much swollen; genae almost wider than the eye. Anterior margin of pronotum very slightly raised, its humeral angles rounded, not projecting. First abdominal segment much shorter and more stubby, little over the length of the second tergite. Male unknown. Cuba. *M. bruneri* Bequaert and Salt.

The two Nearectic species of *Mischocyttarus* are only remotely related. *M. flavitarsis* belongs to the section of the genus most numerous in species, in which the antennae of the male are very slender, with much lengthened segments and with the tip of the flagellum curled up. It is, however, not very closely allied to any of the Neotropical species known to me and could not possibly be confused with any of them. I am inclined to believe that this wasp was originally a member of the true "Californian fauna," which, according to E. C. Van Dyke, "has either been evolved within its own territory or more likely has worked north in early geological times from the lands to the south or Lower California" (1929, Trans. 4th Internat. Congr. Entom., Ithaca, Aug. 1928, II, p. 565). Like many other elements of this fauna, *M. flavitarsis* later worked its way into and even beyond Sonoran territory.

The nearest relatives of *M. cubensis* are *M. bruneri* and *M. phthisicus* in the Antilles; and *M. alfkenii* (Ducke) and *M. basimacula* (Cameron) in Central and South America.²⁶ In all these species, so far as known, the antennae of the male are simple, dif-

²⁶ *M. alfkenii* is the South American species called "*M. indeterminabilis*" by Ducke, R. du Buysson, and Bertoni. *Polybia indeterminabilis* de Saussure (1853-1855, Et. Fam. Vesp., II, p. 201; no sex) was described from "Amérique du Sud. Ile Sainte-Lucie," and has not been properly recognized. Since St. Lucia is the only definite locality mentioned, it should be taken as the type locality. I have, unfortunately, never seen a Polybiine wasp from that island and I am therefore unable to throw light upon *P. indeterminabilis*. The meagre description could apply as well to *P. phthisicus* of the Antilles as to at least three species from Trinidad and the north

fering little from those of the queen and worker: the flagelium is straight and composed of short, broad segments. My key shows the slight, but apparently reliable, structures separating *M. cubensis*, *M. bruneri* and *M. phthisicus*. *M. alfkenii*, which I have seen from eastern Perú and Paraguay, is very closely related to *M. cubensis*, agreeing with it in all the structural characters mentioned in my key. I am unable to find differences in the queens and workers; but in the male of *M. alfkenii* the clypeus appears to be more rectangular and its apex blunter and less projecting than in *M. cubensis*, while the terminal (13th) antennal segment appears to be more stubby. Quite possibly *M. alfkenii* is not really separable from *M. cubensis* var. *mexicanus*, with which it agrees in color. On the other hand, *M. basimacula* is, in my opinion, structurally distinct. It has the asymmetrical claws, the narrow genae, the very short oculo-malar space and the raised pronotal margin of *M. cubensis* and *M. alfkenii*; but it differs from both these species in the much shorter first abdominal segment, which in profile is hardly longer than the second tergite; seen from above, the first tergite is three times as wide at apex as at base, the basal stalk being about one-third the length of the tergite; while, in the male, the clypeus is hardly wider than long (in *M. cubensis* and *M. alfkenii* markedly so). *M. cubensis* may be regarded as a Neotropical element in the autochthonous Greater Antillean fauna, which at a comparatively recent period (probably after the last Glacial Epoch) invaded Florida and gradually spread northward, where it now reaches as far as climatic conditions will allow it.

Distribution.—Like *Nectarina*, the genus *Mischocyttarus* is one of several groups of social wasps that give the Neotropical Region its distinctiveness. Owing to the presence of one species in western North America, it extends from Vancouver to Buenos Aires in northern Argentina. In eastern North America it reaches north-

coast of South America. *M. alfkenii* has also been distributed under the name "*M. bistriatus* F."

M. basimacula (Cameron) (= *Polybia basimacula* Cameron, 1906, *Invertebrata Pacifica*, I, p. 150; ♀), originally described from Belize, I regard as a valid species, structurally different from *M. alfkenii*. It is very common in Central America, where I have seen it from Guatemala, the Republic of Honduras, Costa Rica and Panamá. Records from South America proper, however, appear to be all erroneous and to refer to *M. alfkenii*, which sometimes is colored exactly like *basimacula*. It would seem that Ducke and R. du Buysson confused *basimacula* with *M. cubensis* var. *mexicanus*, which perhaps is not distinct from *M. alfkenii*.

ward to southern Georgia. It also covers the Antilles, but is absent from Chile. The center of density (if not of dispersal) nowadays is Brazil and the Guianas, with 28 species. To the north and the south of that area the species rapidly fall off in numbers (4 species reach northern Argentina; 6, Mexico; 3, the Antilles; 2, the United States).

Most of the species have a rather limited distribution, but this may be partly due to insufficient knowledge. A few, however, cover a very extensive area. Thus *M. ater* (Olivier) (Syn.: *Polybia socialis* H. de Saussure; *Polistes ignobilis* Haliday; *Polybia decepta* Fox; and *Megacanthopus imitator* Ducke) is known from Mexico to Misiones; *M. labiatus* (Fabricius) (Syn.: *Polybia melanaria* Cameron; *Megacanthopus violaceipennis* Cameron; and *Megacanthopus longipetiolatus* Cameron) extends from Tepic, in Mexico, to Uruguay; and *M. drewseni* H. de Saussure (Syn.: *Megacanthopus atriceps* Cameron; and *Megacanthopus rotundicollis* Cameron) from Colombia to Buenos Aires. None of these widely distributed species enter the United States.

Ethology.—The nests are known for at least 18 species of *Mischocyttarus*. I have personally studied those of *M. flavitarsis*, *M. cubensis*, *M. basimacula*, *M. collaris* (Ducke), *M. metathoracicus* (H. de Saussure), and *M. cassununga* (R. von Ihering). The nest is always of the same “gymnodomous and stelocytтарous” type (H. de Saussure) as that of *Polistes*, consisting of a single, free comb of hexagonal paper cells. The shape of the comb, however, varies much with the species. In the two North American forms it hardly differs from that of *Polistes*, but in some of the Central and South American species it becomes very long and narrow, with the stalk at one end and the cells in one or two rows, sometimes placed chain-like one below the other.²⁷ The smaller nests are often attached to leaves. That of the Brazilian *M. artifex* Ducke imitates a dry crumpled-up leaf. The comb of *M. labiatus* is borne on a very long stalk.

According to Ducke, the species of *Mischocyttarus* are monogynous or haplometrotic wasps, which, strictly speaking, would mean that each colony is started normally by a single fertile female or queen. It is, however, not quite clear from published observations how the nests are actually started in nature. From my limited experience, I am inclined to believe that the founding of a new colony is essentially as in *Polistes*, that is, often or usually by a sin-

²⁷ Somewhat similar linear combs are also built by some species of the Old World genus *Ropalidia* (*Icaria*).

gle queen, but occasionally by a small number of fecundated females (not necessarily sisters). In any case, no true swarming has ever been observed in *Mischocyttarus*.

The colonies are always small. Males are often more numerous on the nests than females or workers, while in many other social wasps the reverse is true. The wasps are timid and, as a rule, make no attempt at defending the nest when disturbed. Sometimes they appear to rely on the protection given by ants, as in the case of *M. collaris* Ducke, which I observed near Manáos, Brazil, in August, 1924. Three small nests of this species were placed on the branches of a low bush, and when I attempted to take them, all the wasps flew away without attacking. The same bush, however, was settled by a large colony of the ant, *Dolichoderus (Hypoclinea) abruptus* (Smith) (named by Dr. W. M. Wheeler), which had built brown paper covers over the under side of most of the leaves. When the bush was disturbed, the ants became very angry, running over all the branches and biting furiously, whenever given a chance.

Mischocyttarus flavitarsis (H. de Saussure)

Text Figures 2 and 3. Plate XXIX, Figures 1 to 4

Specific Characters.—*Queen and Worker*.—Head much swollen; seen in front, about as wide as high; seen from above, broadly rectangular and about twice as wide as long; occipital margin very slightly curved inward. Vertex and genae not margined by a carina behind. Genae well developed, in profile about as wide as the eye. Oculo-malar space moderately long, about the length of the seventh antennal segment. Inner orbits about as far apart at the clypeus as on the vertex. Ocelli small, almost in an equilateral triangle; posterior ocelli about as far from the occipital margin as from the inner orbits, but less than half as far apart. Clypeus trapezoidal, at its lower margin nearly one and one-half times as wide as long, contiguous with the inner orbits over a rather short distance (equal to about the length of the oculo-malar space); median lobe of anterior margin moderately projecting, very broadly triangular, with extremely blunt, almost truncate apex, divided by rather deep, broad notches from the slightly projecting lateral lobes. Mandibles short, about one and one-half times as long as wide, with subparallel sides; outer surface very slightly convex; cutting edge slightly oblique, with four teeth, of which the upper one is much shorter and broadly truncate, the three lower ones acute and about equal. Antennae: scape slender, nearly straight, about four times as long as thick at

apex and about as long as the two following segments together; third segment three and one-half times as long as wide at apex, slightly longer than the fourth and fifth together; fourth and fifth longer than wide; sixth and seventh about as long as wide; eighth to eleventh distinctly wider than long; twelfth slightly longer than wide at base; flagellum only slightly and very gradually swollen apicad of the third segment. Thorax as usual in the genus; anterior margin of pronotum straight, very slightly swollen, not carinate; humeral angles, seen from above, broadly rounded and not in the least projecting; mesepisternal suture complete, well marked; propodeum with a broad and deep, median depression in its apical two-thirds, connected above with the postscutellum by means of a narrow, superficial groove. First abdominal tergite much narrower than the remainder of the abdomen, forming a very long and slender petiole; seen from above, it is about three times as long as wide at apex, much shorter than the thorax, but slightly longer than the second tergite; basal half parallel-sided, apical half gradually widened, the apical margin being nearly two and one-half times as wide as the base; spiracles very slightly protuberant on the sides, placed about midway of the tergite; in profile, the petiole is less than two-thirds the length of the thorax, very gradually swollen in its apical half, where it is not much more than one and one-half times as thick as at the base. Legs long and slender, the femora not markedly swollen; tibiae slender at base, much thicker in apical two-thirds; digitiform process on inner side of fourth segment of mid and hind tarsi moderately long, not quite reaching half the length of the fifth segment; apex of third segment of mid and hind tarsi slightly longer on the inner side; claws of mid and hind legs very slightly asymmetrical; mid tibiae with two spurs. Body dull, with the usual microscopic, alutaceous sculpture, which is somewhat coarser than in related species; clypeus with a few, scattered, fine punctures, its apex and the mandibles with more numerous, coarser punctures; otherwise impunctate. Pubescence as usual in the genus. Venation as usual in the genus, differing hardly from that of the genotype, *M. labiatus* (Fabricius).

Male.—Differs from the queen and worker only in the following points: oculo-malar space about two-thirds the length of the seventh antennal segment; face mask-like; clypeus subrectangular (thus appearing more distinctly wider than long), its surface fused with that of the frons over part of its upper margin; its lower margin very slightly protruding, forming a very even, shallow bow; mandibles shorter and broader, somewhat swollen, the lower margin somewhat convex about the

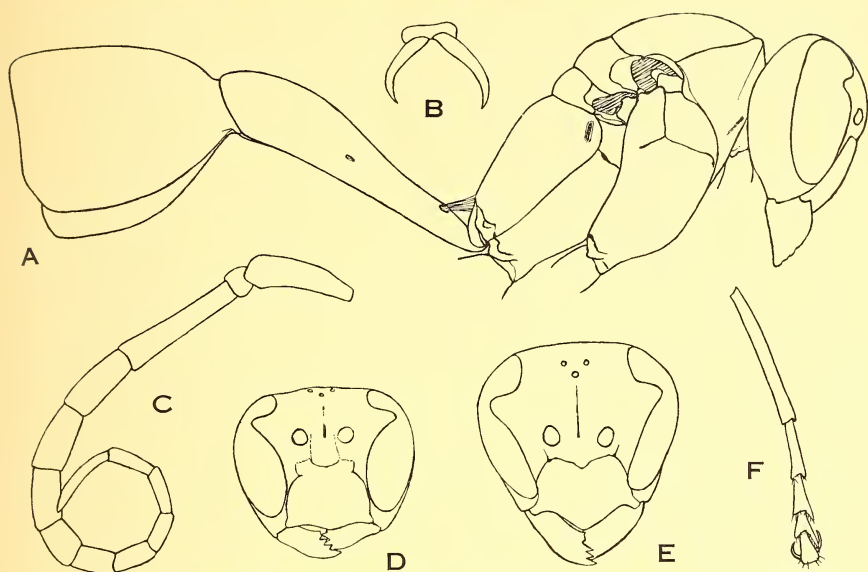


FIG. 2. *Mischocyttarus flavitarsis* var. *navajo* J. Bequaert: A, body of female in profile; B, hind claw of female; C, antenna of male; D, head of male; E, head of female; F, hind tarsus of female.

middle, the four apical teeth unequal in length, the lower tooth being much the longest. Antenna: scape much more swollen, less than three times as long as thick at apex, shorter than the third antennal segment; flagellum long, slightly and very gradually thickened from base to seventh antennal segment, then rather rapidly narrowed to the tip, with a decided tendency to curl up, though not forming a close coil; third antennal segment very long, almost as long as the fourth and fifth together; succeeding segments all much longer than thick, becoming very gradually shorter from the fourth to the ninth, then again gradually longer to the twelfth; the thirteenth very long and cylindrical, nearly straight, with broadly rounded apex, about as long as the fourth segment; none of the segments are flattened on the inner side, nor do they bear swellings or ridges; seventh tergite and sternite broadly rounded at apex; the tergite normally convex; the sternite slightly flattened in its apical half; second abdominal segment shorter and broader than in the female.²⁸

²⁸ H. de Saussure (1853-1855) knew only the female of the typical form. The male of this form was known to Lewis (1897), but he stated merely that it "very closely resembles the ♀." The

Length (h. + th. + t.1 + 2), of typical form and most varieties: queen and worker, 11 to 15 mm.; male, 11 to 13 mm. The var. *navajo* is on the average larger, measuring in queen, worker, and male, 12 to 17 mm. (h. + th. + t.1 + 2). Length of fore wing, 12 to 18 mm.

Coloration.—Any large collection of *M. flavitarsis* exhibits considerable variation in color, and some of the variants are so strikingly different that one might at first be inclined to regard them as distinct species. However, even the most careful study lends no support to this surmise, as it is impossible to correlate structural differences with the color variations. Viereck (1906, Trans. Amer. Ent. Soc., XXXII, p. 231) first recognized that “there are at least three types of coloration in this species representing, perhaps, as many races, of which the dark form is apparently one.” C. L. Hayward (1930, Ent. News, XLI, p. 222; 1932, Proc. Utah Ac. Sci., IX, p. 88) also called attention to the variability of this wasp and, in addition, pointed out that specimens from a given locality often have a marked likeness in color. With the rather extensive material before me, and taking in consideration the geographical distribution of the several variants, I have been led to recognize by name the five color variants of the subjoined key.

KEY TO COLOR FORMS (QUEENS AND WORKERS)

1. Wings strongly infuscated, with pronounced purplish effulgence2.
- Wings moderately clouded, amber-yellow with russet veins and costal cell; usually darker and slightly purplish in the radial cell3.
2. Thorax black, without or with few ferruginous blotches and with reduced yellow markings. Petiole as a rule black or slightly brownish (rarely ferruginous), with broad yellow apex; remainder of abdomen mostly yellow. (Southern Arizona).
var. *navajo* J. Bequaert.
- Ground color of body ferruginous, with mere traces of black. Yellow markings of thorax reduced. Yellow fasciae of abdomen rather narrow, mostly replaced by ferruginous. (Northern Arizona)var. *kaibabensis* J. Bequaert.
3. Black color partly or mostly replaced by red or ferruginous red (at least the petiole or first tergite mostly ferruginous, except for the apical yellow fascia); in extreme cases the

first description of the male was by Ducke (1908), who saw specimens from Colorado, New Mexico and Arizona, therefore not of the typical color form.

thorax wholly ferruginous with yellow spots; base of second tergite as a rule extensively ferruginous. (Southern Utah and Colorado to New Mexico)var. *centralis* J. Bequaert.

Ferruginous color usually absent or restricted to blotches on the base of the second tergite (toward the yellow area); petiole or first tergite black, with an apical yellow fascia which is often somewhat brownish or reddish anteriorly.....4.

4. Bright yellow color very extensive: abdomen behind the petiole mostly of that color (except for the narrow reddish and black base of second segment); yellow spots of thorax large (usually present on mesopleura and coxae). (Oregon, California, Utah, Colorado and Nebraska).

typical *flavitarsis* (de Saussure).

Yellow markings much reduced: abdominal segments with fairly narrow, apical yellow fasciae; thoracic spots small (those of mesopleura and coxae as a rule lacking). (Utah, Oregon, Montana, Idaho, Washington State and British Columbia.)

var. *idahoensis* J. Bequaert.

Three of the five varieties recognized in this key are much less marked in the male sex. I have not seen enough males to reach definite conclusions; but it would seem that in that sex the black color is as a rule more extended than in the corresponding queens and workers from the same locality. The male of the var. *navajo* is as distinct as its female; that of the var. *kaibabensis* is as yet unknown. A thorough study of color variation within the colony, covering all queens, workers and males, caught on or bred from each nest, would help much toward clearing up the several variants of the species.

Distribution. (Text Figure 3).—In its several color variants, *M. flavitarsis* occurs over most of the United States west of the 100th Meridian, this wasp being one of the characteristic insects of that territory. I have seen it from Washington State, Oregon, California, Idaho, Montana, Utah, Arizona, Colorado, New Mexico, eastern Nebraska and eastern Texas. It undoubtedly will be found in Nevada and Wyoming; perhaps also in the eastern Dakotas, eastern Kansas and northeastern Oklahoma. The northermost locality known to me is Lillooet, British Columbia (50° 43' N.; 121° 56' W.); the southermost record is from the Chisos Mts., Brewster Co., Texas (in about 29° N. lat.). The only Mexican locality thus far is "Meadow Valley," somewhere in northern Chihuahua, close to the border of New Mexico. There is little doubt, however, that this wasp occurs in various other localities of the Mexican States of Coahuila, Chihuahua, and Sonora. It is found quite generally

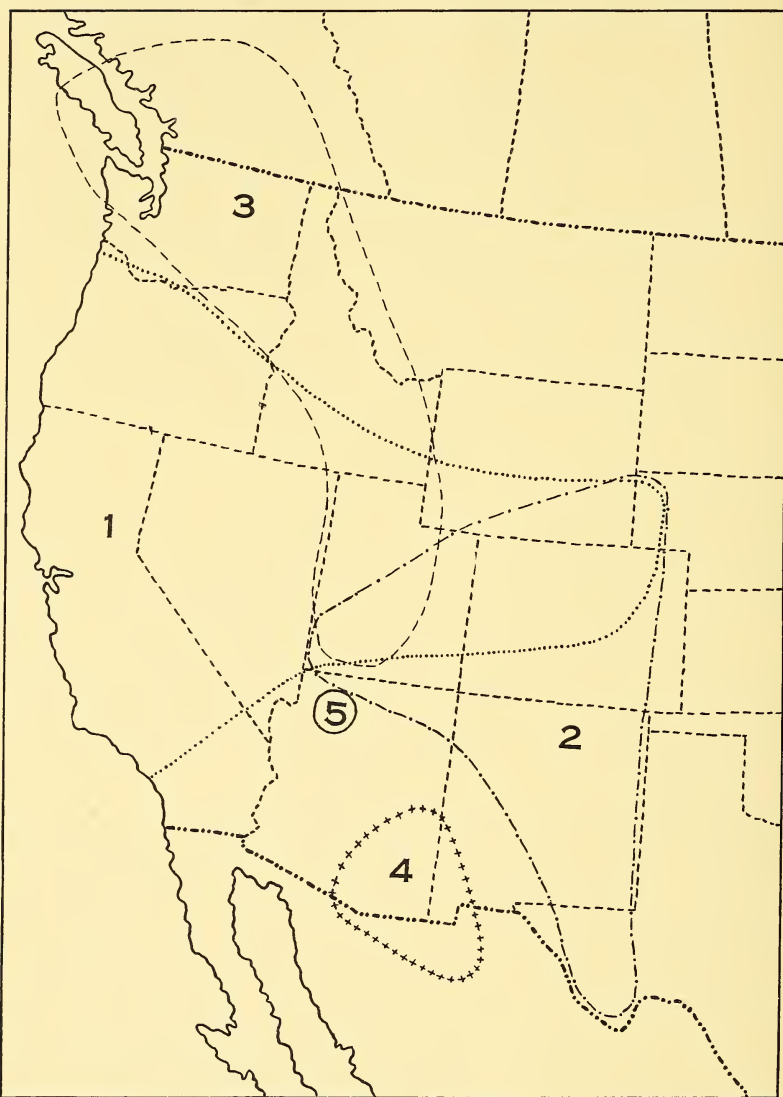


FIG. 3. Distribution of the several color forms of *Mischocyttarus flavitarsis* (H. de Saussure) in western North America: 1, typical form; 2, var. *centralis* J. Bequaert; 3, var. *idahoensis* J. Bequaert; 4, var. *navajo* J. Bequaert; 5, var. *kaibabensis* J. Bequaert.

from sea-level to about 8,000 ft. ; it is doubtful whether it nests above that altitude. In the northern part of the range (in Idaho and Utah, for instance), it does not appear to extend as high up the mountains as farther south.

The typical (or first described) color variant is decidedly xanthic and, of the several forms, covers the largest area, including Oregon, California, Utah and Colorado. Although characteristic of the Pacific Coast Region, farther east it enters territory occupied also by two other variants (var. *idahoensis* and var. *centralis*), with which, moreover, it intergrades. The melanic form (var. *idahoensis*) extends farthest north, being found mainly in the Upper Sonoran and to some extent in the Transition life zones. The erythric form (var. *centralis*) seems to inhabit chiefly the Upper Sonoran life zone of Utah, Colorado, Nebraska, New Mexico, and eastern Texas. In the Upper Sonoran xerophytic forest of the mountain ranges of south-eastern Arizona this erythric form is replaced by a most peculiar variant (var. *navajo*), which, perhaps more than any of the other forms, might claim to rank as a geographical race or subspecies. The var. *kaibabensis* is equally striking, but known thus far only from the Grand Canyon, in northwestern Arizona. Moreover, the possible correlation of the several variants with the different life zones or ecological vegetation types, as summarily sketched above, needs to be investigated much more carefully on the spot. It is, for instance, at present impossible to tell which ecological environment is favored by the typical form in California. From the records available to me, it would seem to inhabit chiefly the Transition zone, perhaps also the Upper Sonoran, and to be absent from the Lower Sonoran.

Ethology.—Few observations on the habits of *M. flavitarsis* are available. Essig (1926) says that it builds small, single-combed, unenveloped paper nests, usually smaller than *Polistes*, under rocks, logs, caves, banks and in buildings, and that the food consists largely of insects. C. L. Hayward (1932) states that it is “very similar in habits to the members of the genus *Polistes*. The nests are very similar in structure, although the colonies of *Mischocyttarus* are generally smaller.”

Professor H. A. Scullen writes me that, in the vicinity of Corvallis, Oregon, the nests are rare: “This last spring (1932) a female of *M. flavitarsis* started her nest between the covers of one of my bee hives. I endeavored to disturb her as little as possible, but evidently the frequent interruption of her work discouraged her and she disappeared.” This observation, relating to the typical

color variant, is of interest, because it indicates that this species is haplometrotic or monometrotic, a single fertile female (or queen) starting the new nest after hibernation.

A nest of the var. *navajo* was found at Mud Springs, Pine Canyon, Santa Catalina Mts., Arizona, in the latter half of July, 1916, by Dr. F. E. Lutz, at an altitude of 6,800 ft. The vegetation of the region consisted of oak, pinyon pine, juniper, walnut and a slight sprinkling of *Agave*. (Shelford's "Xerophytic Coniferous Forest," in Merriam's "Upper Sonoran Life Zone.") Dr. Lutz's field notes state that "the nest was placed under the over-hanging dead blades of a clump of bunch grass and was completely hidden." It evidently was built a short distance from the ground. It consists of a single, almost flat comb of paper cells, about 38 mm. long, 25 mm. wide and 20 mm. high (this being the height of the largest cell). There are about 45 cells, which reach about 5 mm. in diameter when completed; but most of the cells are rather short or barely started. The nest is built of a tough, coarse, gray paper similar in appearance, material, and texture to that of *Polistes fuscatus* var. *pallipes*. It very distinctly consists of wood fibres. Most of the cells were empty, but one contained a pupa, and this cell had been capped over with a thin membrane evidently made by the full-grown larva. The short stalk is eccentric, placed at the upper end, so that the hanging comb is almost vertical, the cells at the upper end being horizontal, those at the lower end vertical and opening downward. Photographs of this nest are reproduced in Plate XXIX, Figures 1 and 2.

A nest of the typical form of the species was received from Professor H. A. Scullen, who found it near Corvallis, Oregon, August 18, 1924. It is similar to the foregoing, 45 mm. long, 25 mm. wide and 18 mm. high, of about 55 cells, most of them completed. The stalk was placed about the middle of the length, but slightly to one side. Figures 3 and 4, of Plate XXIX, are photographs of this nest, which unfortunately was rather poorly preserved.

The larva and pupa are not available for description.

M. flavitarsis appears to be much subject to the attacks of parasites of the order Strepsiptera. W. D. Pierce (1918, Proc. U. S. Nat. Mus., LIV, p. 490) records a stylopized specimen from Stone Cabin Canyon, Santa Rita Mts., Arizona (evidently of the var. *navajo*, although I have not seen it). In the several collections studied, I have found the following stylopized examples:

1. Female of var. *centralis*; Cimarron, Colorado; with four ♂: t. 3, 1; s. 3, r.; s. 4, 1; s. 5, r.

2. Female of var. *centralis*; Bryce Canyon, Utah; with one ♀: t. 4, 1.

3. Female of var. *centralis*; Jemez Springs, New Mexico; with one ♀: t. 4, 1.

4. Female of var. *centralis*; Jemez Springs, New Mexico; with one ♀: t. 4, 1.

5. Female of var. *navajo*; Fort Grant, Arizona; with one ♀: t. 4, r.

6. Female of var. *navajo*; Oak Creek Canyon, Arizona; with six males and one female: t. 3, two; s. 3, one; t. 4, two; s. 4, one; t. 5, one.

A careful comparative study of these styloped females fails to show any appreciable tendency toward male characters, either in structure or in color.

M. flavitarsis, typical form

Polybia flavitarsis H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 199 (♀; California; holotype in British Museum). F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 130, Pl. V, fig. 1. Walsh and Riley, 1869, Americ. Entom., I, p. 142. Cresson, 1887, Trans. Amer. Ent. Soc., Suppl. Vol., p. 290. Dalla Torre, 1894, Cat. Hym., IX, p. 163; 1904, Gen. Insect., Vesp., p. 77. Lewis, 1897, Trans. Amer. Ent. Soc., XXIV, p. 190, Pl. I, fig. 3 (♀ ♂). Kellogg, 1905, American Insects, 1st Ed., p. 507; 1908, *Ibid.*, 2d Ed., p. 507.

Megacanthopus (?) *flavitarsis* Ducke, 1907, Bol. Mus. Goeldi, Pará, V, p. 190.

Megacanthopus flavitarsis Meade-Waldo, 1911, Ann. Mag. Nat. Hist., (8) VII, p. 111.

Mischocyttarus (*Myrapetra*) *flavitarsis* Essig, 1926, Insects of Western North America, p. 888, fig. 750 (♀).

The foregoing references refer exclusively to the typical form of the species; but the following were based upon a mixture of several of the varieties here recognized.

Megacanthopus flavitarsis Ducke, 1908, Deutsch. Ent. Zeitschr., p. 698 (♀ ♂; from Colorado, New Mexico and Arizona).

Mischocyttarus flavitarsis Hayward, 1930, Ent. News, XLI, p. 222 (♀ ♂; from Utah, California, Arizona and Idaho); 1932, Proc. Utah Ac. Sci., IX, p. 88, Pl. IX, fig. 30 (from Utah, Idaho and Arizona).

Specimens Examined.—CALIFORNIA: Giant Forest, Tulare Co. (R. C. Shannon); Pasadena, Los Angeles Co.; Arroyo Seco, S.

Pasadena; Claremont, Los Angeles Co.; Mt. Wilson, Los Angeles Co.; San Antonio Canyon, N. of Ontario, San Bernardino Co., 3,950 ft.; S. fork of Kaweah R., Tulare Co., below 6,500 ft.; Santa Barbara, Santa Barbara Co.; Felton, Sa Cruz Mts., Sa Cruz Co., 300-500 ft.; Stanford University; Palo Alto, San Mateo Co.; San Clemente, Marin Co.; Watsons, Sonoma Co.; Cazadero, Sonoma Co.; Mt. Shasta district, Siskiyou Co.—OREGON: Eleven miles north of Grants Pass, Josephine Co., 1,350 ft.; Grave Creek, Josephine Co.; Eugene, Lane Co.; Corvallis, Benton Co.; Silverton, Marion Co.; McKenzie Bridge; Coe's Valley; Hugo.—UTAH: Beaver Canyon, Beaver Creek Hills, and Wildcat Valley, Beaver Co.; Springville, Utah Co.; Rock Canyon, Provo, Utah Co.; Salt Lake City; Ogden, Weber Co., 4,300 ft.; Logan, Cache Co.; Raft River Mts., Boxelder Co., 10,000 ft.; Dividend, Utah Co.—COLORADO: Boulder, Boulder Co., 5,500 ft.; Jim Creek near Boulder, 4,795 ft.; Springdale, Boulder Co., 5,580 ft.; Platte Canyon, Jefferson Co.; Glenwood Springs, Garfield Co., 5,800 ft.; Palisades, Mesa Co., 4,740 ft.; Ft. Collins, Larimer Co.; Poudre River, Larimer Co.—NEBRASKA: Sioux Co.

H. de Saussure described the color of the typical form as follows: "Head black; clypeus, mandibles, orbits, a V on the vertex, a triangle on the frons, yellow. Antennae orange; the first segment yellow anteriorly, somewhat dark above. Thorax black; the two margins of the prothorax, a spot beneath the wing, anterior margin of scutellum and postscutellum, and two pear-shaped spots on the propodeum, yellow. Tegulae russet. Abdomen yellow; base of second segment and petiole black; the petiole yellow at apex. Legs black; knees, tibiae and tarsi yellow, variegated with russet; coxae spotted with yellow. Wings ferruginous, the apex gray. The black area at the base of the second segment is rather irregular."

This description covers most of the extreme xanthic specimens, found throughout California and western Oregon; but the wings are yellowish rather than ferruginous, with the veins, the stigma and the costal cell ferruginous; the yellow of the knees often extends over part of the femora and may almost reach the base on the under side of the fore femora; usually the bases of mid and hind femora and their trochanters are spotted with yellow on the upper side. Exceptionally the mesonotum bears two curved, yellow lines, and there may be yellow spots on the lower part of mesopleura and on metapleura. In some of the Californian specimens the black base of the second segment turns reddish brown at the limit with the yellow.

Some of the specimens from Utah and Colorado differ from those from California only in the reduction of the yellow lines on the vertex or the absence of spots on the coxae. In others, however, many of the yellow markings of the thorax disappear, while the black base of the second segment is much broader. Such specimens are transitional between the typical form and the var. *idahoensis*. In Utah and Colorado also, the middle of the first and second tergites is often more or less brownish to ferruginous, such specimens forming the passage to the var. *centralis*.

In California, the males are even more abundantly marked with yellow than the females and workers. The head is almost entirely yellow, except for the black vertex and occiput (the occiput sometimes mostly yellow and the vertex as a rule with two oblique yellow lines). The under side of thorax, coxae, femora and petiole also is very extensively yellow.

In many males from Utah and Colorado, the yellow is much less extensive on the abdomen than in the workers and females taken in the same localities. It would seem that in that sex the typical form cannot be distinguished there from the var. *idahoensis*.

In California, typical *M. flavitarsis* is homeochromic with ("mimics") *Polistes fuscatus* var. *aurifer* (de Saussure), *Ancistrocerus sutterianus* de Saussure, and some other local insects.

M. flavitarsis var. **centralis**, new variety

Polybia flavitarsis Ashmead, 1890, Colorado Biol. Assoc. Bull. No. 1, p. 34 (Colorado). Viereck, 1903, Trans. Amer. Ent. Soc., XXIX, p. 68 (♂; Beulah, New Mexico).

Specimens Examined.—UTAH: Cedar City, Iron Co., one female paratype (I. N. Hayward.—B. Y. Univ.); Bryce Canyon, Garfield Co., one female paratype (V. M. Tanner.—M.C.Z.); Buckskin Valley, Iron Co., one female paratype (U.S.N.M.); Ute Mts., Uintah Co., one female paratype (V. M. Tanner.—B. Y. Univ.); Beaver Creek Hills, Beaver Co., two female paratypes (U.S.N.M.); Zion National Park, Washington Co., one female paratype (V. M. Tanner.—B. Y. Univ.); Moab, Grand Co., one female paratype (V. M. Tanner.—B. Y. Univ.); Jensen, Uintah Co., six female paratypes (G. Fairchild).—COLORADO: Glenwood Springs, Garfield Co., 5,800 ft., one female paratype (A.M.N.H.); Montrose, Montrose Co., one female paratype (A.M.N.H.); Animas, La Plata Co., 6,600 ft., one female paratype (A.M.N.H.); Boulder, Boulder Co., two female paratypes (H. Holt); Springdale, Boulder Co., 5,580 ft., one female paratype (T. D. A. Cockerell.—M.C.Z.); Custer Co., one

female paratype (T. D. A. Cockerell.—U.S.N.M.); Ft. Collins, Larimer Co., three female paratypes; Rifle, Garfield Co., one female paratype (S. A. Rohwer.—U.S.N.M.); Manitou, El Paso Co., three female paratypes (E. P. Van Duzee.—Cal. Acad. Sci. and U.S.N.M.); Mesa Verde, Montezuma Co., 6,600 to 8,000 ft., three female paratypes (J. Bequaert.—M.C.Z.; A.M.N.H.); Texas Creek, Fremont Co., one female and one male paratypes (R. C. Shannon.—Cornell Univ.); Cimarron, Montrose Co., one female paratype (R. C. Shannon.—M.C.Z.); Palisades, Mesa Co., 4,700 ft., one female paratype (C. L. Hayward).—NEBRASKA: Squaw Canyon, Sioux Co., two female paratypes (H. G. Barber.—M.C.Z.).—NEW MEXICO: Las Vegas, San Miguel Co., two female paratypes (Barber and Schwarz.—U.S.N.M.); Jemez Springs, Sandoval Co., one female holotype (M.C.Z.), one male allotype (M.C.Z.), fourteen female paratypes, and one male paratype (John Woodgate.—Cornell Univ.; M.C.Z.).—TEXAS: Chisos Mts., Brewster Co., eight female paratypes (Mitchell and Cushman.—U.S.N.M.); Limpia Canyon, Davis Mts., Jeff Davis Co., 5,000–5,500 ft., one female paratype and two male paratypes (J. C. Bradley.—Cornell Univ.).—Also seven female paratypes from Colorado, without definite locality (U.S.N.M.).²⁹

Queen and Worker.—This form is characterized by the partial replacement of black by ferruginous red. In the holotype, from Jemez Springs, New Mexico, most of the areas of the abdomen usually black have become ferruginous; on the thorax only the pronotum, scutellum and femora show a touch of reddish brown; the yellow markings are very extensive and much as in the typical form. Some of the paratypes from Jemez Springs show two ferruginous curved lines on the mesonotum. Most of the specimens from Utah and Colorado which I refer to the var. *centralis* differ little from the holotype; but one finds together with them specimens which differ from typical *flavitaris* only in having reddish blotches on the black base of the petiole. In one female from Moab, Utah, the black of the body is replaced almost everywhere by ferruginous (a large, irregular ocellar spot on the vertex and a narrow median line on the mesonotum are the only black areas left); this specimen differs from the var. *kaibabensis*, described below

²⁹ Since the MS was sent to the printer, additional paratypes of *M. f.* var. *centralis* have been seen from: Zion National Park, Utah, three females (R. H. Beamer and P. W. Oman); Colorado, one female; Manitou, Colorado, one female (E. S. Tucker); near Las Vegas Hot Springs, New Mexico, three females (F. H. Snow); Clouderoft, New Mexico, four males (R. H. Beamer). All in Kansas Univ.

from the Grand Canyon, merely in the decided yellow tinge of the wings and the presence of yellow spots on pleura and pronotum.

The *males*, which from the geographical distribution should belong, at least partly, to the var. *centralis*, are not clearly characterized, since the ferruginous areas of the abdomen are more or less blotched with black, or even entirely replaced by that color.

The var. *centralis* is perhaps the most poorly defined of the several variants of the species. One finds it in several localities together with the typical form, and occasionally transitional specimens are met with. Yet it is so frequently seen in Colorado, Utah and New Mexico, while it is altogether unknown farther west and north, that it must have some significance as a geographic variation. I suspect that, like var. *navajo*, it is correlated with peculiar ecological conditions, which, however, I am unable to trace at present.

In Utah and Colorado, *M. flavitarsis* var. *centralis* is homeochromic with *Polistes fuscatus* var. *centralis* Hayward (1933, Proc. Utah Ac. Sci., X, p. 143).

M. flavitarsis var. *navajo*, new variety

Polybia flavitarsis Viereck, 1906, Trans. Amer. Ent. Soc., XXXII, p. 231 (♀; Oak Creek Canyon, 6,000 ft., Coconino Co., Arizona). Snow, 1907, Trans. Kansas Ac. Sc., XX, pt. 2, (1906), p. 131 (Oak Creek Canyon, 20 miles S.W. of Flagstaff, 3,000 ft.; and Baboquivari Mts., 3,750 ft., Pima Co., Arizona).

Meganthopus flavitarsis Pierce, 1918, Proc. U. S. Nat. Mus., LIV, p. 490 (Stone Cabin Canyon, Sa. Rita Mts., Sa. Cruz and Pima Cos., Arizona).

Mischocyttarus flavitarsis Salt and Bequaert, 1929, Psyche, XXXVI, p. 261.

Specimens Examined.—ARIZONA: Ramsey Canyon, Huachuca Mts., Cochise Co., thirteen female paratypes and one male paratype (J. C. Bradley and J. D. Hood.—Cornell Univ.); Post Creek Canyon, Fort Grant, Pinaleno Mts., Graham Co., 6,000 ft., one female holotype (M.C.Z.), one male allotype (M.C.Z.), sixteen female paratypes, and five male paratypes (J. C. Bradley and J. Bequaert.—Cornell Univ.; M.C.Z.); Palmerlee (or Garces), Cochise Co., seventeen female paratypes and fifteen male paratypes (C. R. Biederman.—A.M.N.H., M.C.Z., U.S.N.M., and Cornell Univ.); Kits Peak, Rincon, Baboquivari Mts., Pima Co., 4,050 ft., two female paratypes and one male paratype (A.M.N.H., M.C.Z.); Mud Springs, Sa. Catalina Mts., Pima Co., 6,500 ft., eight female para-

types collected on a nest (A.M.N.H.); Sabino Basin, Sa. Catalina Mts., Pima Co., 3,800 ft., eight female paratypes (A.M.N.H.); Apache Camp, Sa. Catalina Mts., Pima Co., 5,500 ft., two female paratypes (J. Bequaert.—M.C.Z.); Bisbee, Cochise Co., one female paratype (Curtis.—B. Y. Univ.); Cochise Co., one female paratype (V. W. Owen.—Cal. Acad. Sci.); Williams, Coconino Co., one male paratype (Barber and Schwarz.—U.S.N.M.). Also several female and male paratypes from Southern Arizona, without more definite locality (M.C.Z. and U.S.N.M.).—CHIHUAHUA (Mexico): Meadow Valley, one female paratype (C. H. T. Townsend.—U.S.N.M.; this locality, Prof. T. D. A. Cockerell tells me, is in the Sierra Madre, somewhere near the western border of the State of Chihuahua).³⁰

Queen and Worker.—Black, with yellow markings as follows: clypeus, under side of scape, lower inner orbits (up to the bottom of the ocular sinus), small spots on the face near the base of the antennae (the upper pair forming oblique lines), very broad outer orbits, two oblique lines on the vertex (converging behind), narrow anterior and posterior margins of pronotum (sometimes much broadened), anterior half or more of scutellum, narrow anterior margin of postscutellum, a small elongate spot in the upper edge of mesopleura, a spot at base of femora above, knees, apices of tibiae, tarsi, broad apical margin of first tergite (petiole), and most of abdomen behind the petiole (except the irregular, brownish black base of 2d segment). Mandibles, oculo-malar space, upper side of scape, basal half of flagellum and a line on the under side of its apical half, tegulae, and most of femora, ferruginous (usually more or less suffused with yellow). In some specimens the mesonotum bears two curved, orange-yellow or russet lines. On head and thorax the yellow is usually more or less orange, while on the abdomen it is as a rule much paler. Wings strongly infuscated, with a decided purplish effulgence; veins brownish black; stigma russet.

Male.—Head almost wholly pale yellow (except for the broad black vertex); under side of thorax, coxae and under side of femora extensively yellow; upper corner of mesopleura usually and propodeum sometimes spotted with yellow; abdomen either as in the female or the brownish-black base of the second segment more extensive.

³⁰ Since the MS was sent to the printer, I have seen 52 additional paratypes of *M. f.* var. *navajo* from: Southern Arizona; Sa. Rita Mts., 5,000 to 8,000 ft. (F. H. Snow); Oak Creek Canyon, 6,000 ft. (F. H. Snow); Baboquivari Mts. (F. H. Snow); Huachuca Mts. (R. H. Beamer); Chiricahua Mts. (R. H. Beamer); (all localities in Arizona). All in Kansas Univ.

This variety averages larger than the other forms of the species.

M. flavitarsis var. *navajo* is one of the characteristic members of the Upper Sonoran fauna in the xerophytic forest of junipers, pinyons and evergreen oaks, between 5,000 and 7,000 ft., on the slopes of the several small mountain ranges of southeastern Arizona. Here it is one of a group of insects that exhibit a remarkable parallelism, or deceptive resemblance, in coloration. This homeochromic group includes also the wasps, *Polistes canadensis* var. *navajo* (Cresson) and *Ancistrocerus navajo* J. Bequaert, as well as the syrphid fly, *Sphiximorpha loewii* (Williston). I have taken these three insects, flying together with *M. flavitarsis* var. *navajo*, in Post Creek Canyon, at an altitude of about 6,000 ft., July 17, 1917.

M. flavitarsis var. **kaibabensis**, new variety

Specimens Examined.—ARIZONA: Bright Angel Trail, Grand Canyon, Cococino Co., one female, holotype (Cornell Univ.) and one female paratype (M.C.Z.); both collected by R. C. Shannon, on the Cornell Biological Expedition, August 4, 1917.

Queen and Worker.—The extreme erythric form of the species. Body bright ferruginous red; only the edge of the clypeus, the teeth of the mandibles, and the sutures of scutellum and postscutellum blackish; with rather reduced yellow markings as follows: clypeus, lower half of face, broad outer orbits, mandibles, two oblique lines on vertex, narrow anterior and posterior margins of pronotum, a diffuse spot in the upper corner of the mesopleura, most of scutellum and postscutellum, tegulae, apices of femora, most of tibiae and tarsi, and moderately wide apical fasciae on all abdominal segments (gradually passing into the ferruginous areas); base of antennae and under side of coxae and femora somewhat yellowish. Wings strongly infuscate, with a purplish tinge; stigma and veins russet; base of wing and a diffuse blotch beneath the stigma clearer, more yellowish; extreme apical margin of fore wing subhyaline.

The var. *kaibabensis* is a perfect parallel in color (or "mimic") of *Polistes canadensis* var. *kaibabensis* Hayward, which occurs in the same district. It is chiefly for this reason that I have given it a name. It evidently combines the erythric tendency of the var. *centralis* with the peculiar coloration of the wing of the var. *navajo*.

M. flavitarsis var. **idahoensis**, new variety

Specimens Examined.—WASHINGTON STATE: Blewett Pass, Chelan Co., one female paratype (A. L. Melander.—M.C.Z.); Lake

Chelan, Stehekin, Chelan Co., one female paratype (A. L. Melander.—M.C.Z.).—OREGON: Wallowa Lake, Wallowa Co., 4,500 to 5,500 ft., one female paratype (H. A. Scullen).—IDAHO: Warren, Idaho Co., one female holotype and one female paratype (M.C.Z.).—UTAH: Springville, Utah Co., one female and one male, paratypes (C. L. Hayward.—B. Y. Univ.); Rock Canyon, Provo, Utah Co., four female paratypes (C. L. Hayward.—B. Y. Univ.); Provo, Utah Co., one female paratype (C. L. Hayward.—B. Y. Univ.); Cedar City, Iron Co., one male allotype (I. N. Hayward.—M.C.Z.).—BRITISH COLUMBIA: without more definite locality, one female paratype (Can. Ent. Coll.); Victoria, Vancouver Island, seven female paratypes and one male paratype (W. B. Anderson; G. J. Spencer; R. C. Treherne; H. Hugh; K. F. Auden; R. Glendenning.—Can. Ent. Coll.); Sooke Rock, Vancouver Island, six female paratypes (W. B. Anderson.—Can. Ent. Coll.); Danby, Vancouver Island, one female paratype (Can. Ent. Coll.); Goldstream, Vancouver Island, one female paratype (Tom Wilson); Lillooet, one female paratype and two male paratypes (A. W. Phair; W. B. Anderson.—Can. Ent. Coll.); Oliver, 1,200 ft. (40 miles S. of Penticton), six female paratypes (C. B. Garrett.—Can. Ent. Coll.); Nanaimo, one female paratype (G. J. Spencer); Keremeos, eight female paratypes (W. B. Anderson; G. B. Garrett.—Can. Ent. Coll.); Thompson River, three female paratypes (T. Wilson.—Can. Ent. Coll.); Osoyoos, two female paratypes (Can. Ent. Coll.); Summerland, two female paratypes (F. W. L. Sladen.—Can. Ent. Coll.); Kelowna, one male paratype (C. G. Hewitt.—Can. Ent. Coll.); Vernon, one female paratype (E. P. Venables.—Can. Ent. Coll.); Lytton, two female paratypes (W. B. Anderson.—Can. Ent. Coll.; and G. J. Spencer); West Bank, two female paratypes (E. R. Buckell); Okanagan Falls, ten female paratypes (F. W. L. Sladen; E. M. Anderson.—Can. Ent. Coll.); Vancouver (city or island?), one female paratype and one male paratype (C. F. Baker Coll.—U.S.N.M.); Vancouver City, two male paratypes (G. J. Spencer).³¹

Queen and Worker.—This is the dark, or melanic, form of the species. The holotype (from Warren, Idaho) is black with the following parts yellow: clypeus; narrow lower inner orbits

³¹ Since the MS was sent to the printer, I have seen additional paratypes of *M. f.* var. *idahoensis* from: Weeksville, Sanders Co., Montana, one female (S. Henshaw and H. Hagen.—M. C. Z.); Salt Lake City, two males (J. Nottingham); Weber Canyon, Utah, one female, (L. D. Anderson); Lytton, B. C., three females (R. H. Beamer); Vernon, B. C., one female (J. Nottingham). All in Kansas Univ., except the first.

(reaching the bottom of the ocular sinus); a small frontal, oblique mark near the base of each antenna; broad outer orbits; narrow anterior and posterior margins of pronotum; moderately broad anterior margin of scutellum and postscutellum; a narrow, wedge-shaped spot in the lower half on each side of the propodeum; apical fasciae on all abdominal tergites and sternites (narrowest on 1st, 2nd and 3rd; that of the second tergite covering in the middle about one-fourth of the length, much broadened along the sides; the fasciae on 2d and 3d segments are bi-emarginate or bear a pair of blackish spots); broad apices of femora; and most of tibiae and tarsi. Antennae (except the yellow under side of the scape), lower third of clypeus, mandibles, oculo-malar space, tegulae, under side of tibiae, and claws, reddish brown to ferruginous. Wings as in the typical form. Many of the specimens from Washington State, Utah and British Columbia, which I refer to this variety, have broader yellow fasciae on the abdomen (covering about half of the 2d tergite), but the markings of head, thorax and legs are much as in the holotype. In British Columbia the outer orbits are sometimes only very narrowly yellow, while the clypeus may be mostly black, with or without median yellow spots. The darkest specimens seen are from Sooke Rock, Vancouver Island. Exceptionally part of the second abdominal tergite is somewhat ferruginous.

Male.—More extensively yellow than the female, the head (except for the broad black vertex), the under side of the thorax, and the anterior half of the mesopleura of that color. Legs mostly yellow, except for the black upper side of the femora; in some males the femora are black with a narrow yellow line beneath. Antennae mostly orange yellow, the upper side of the scape black.

The var. *idahoensis* undoubtedly occurs also in Wyoming, a state whence I have seen no *Mischocyttarus* thus far. Much of the area occupied by this color form (notably in southeastern Idaho, northeastern Utah, northwestern Colorado and southwestern Wyoming) is also inhabited by a race of *Polistes fuscatus*, extremely similar in color pattern. This homeochromic *Polistes* was sent to me by Mr. C. Lynn Hayward, who described it recently as *P. fuscatus* var. *utahensis* (1933, Proc. Utah Ac. Sci., X, p. 142). Another homeochromic wasp of Utah is the psammocharid, *Batazonus flavipennis* N. Banks.

Mischocyttarus cubensis (H. de Saussure)

Text Figure 4. Plate XXIX, Figures 5 and 6

Specific Characters.—*Queen and Worker*.—Head transverse, slightly wider than the thorax; seen in front, wider than

high; seen from above, rectangular and not quite three times as wide as long; occipital margin rather strongly curved inward in its median half. Vertex and genae not margined by a carina. Genae well developed and moderately swollen behind the eyes, in profile distinctly narrower than the eyes. Oculo-malar space very short, though present, but much less than the length of the eighth antennal segment. Inner orbits distinctly farther apart on the vertex than at the clypeus. Ocelli large, in an equilateral triangle; posterior ocelli about as far from the eyes as from the occipital margin, but much nearer to each other. Clypeus slightly wider than long, transversely pentagonal, contiguous with the inner orbits over a little less than half the upper lateral margins; median lobe of anterior margin moderately projecting and not deeply separated from the rather inconspicuous lateral lobes; the apex itself broadly obtuse. Eyes usually bare; sometimes with a few, minute, much scattered hairs, visible only with high magnification. Mandibles moderately long, about twice as long as wide, with subparallel sides; outer surface very slightly convex; cutting edge slightly oblique, with four teeth, of which the upper one is much smaller, the three lower ones about equal. Antenna: scape slender, nearly straight, slightly more than three times as long as thick at apex and about as long as the two following segments together; third segment much longer than the fourth and fifth together; fourth slightly longer than wide; fifth about as long as wide; sixth to eleventh distinctly wider than long; twelfth slightly longer than wide at base; flagellum distinctly swollen apicad of third segment. Thorax as usual in the genus; anterior margin of pronotum slightly curved, much raised and carinate on the sides; humeral angles, seen from above, distinctly projecting, though blunt; mesepisternal suture complete, well marked; propodeum with a rather shallow and broad longitudinal groove. First abdominal tergite much narrower than the remainder of the abdomen, forming a long and slender petiole; seen from above, about three times as long as wide at apex, considerably shorter than the thorax, but distinctly longer than the second tergite; narrow basal half parallel-sided; apical third, seen from above, about twice as wide as the base into which it passes quite gradually; spiracles slightly protuberant on the sides and placed about midway of the tergite; in profile, the petiole is very gradually swollen posteriorly, where it is a little thicker than at the base. Legs long and slender; femora not appreciably swollen; digitiform processes of the mid and hind tarsi long, those of the fourth segment reaching much beyond the middle of the fifth segment; claws of mid and hind legs

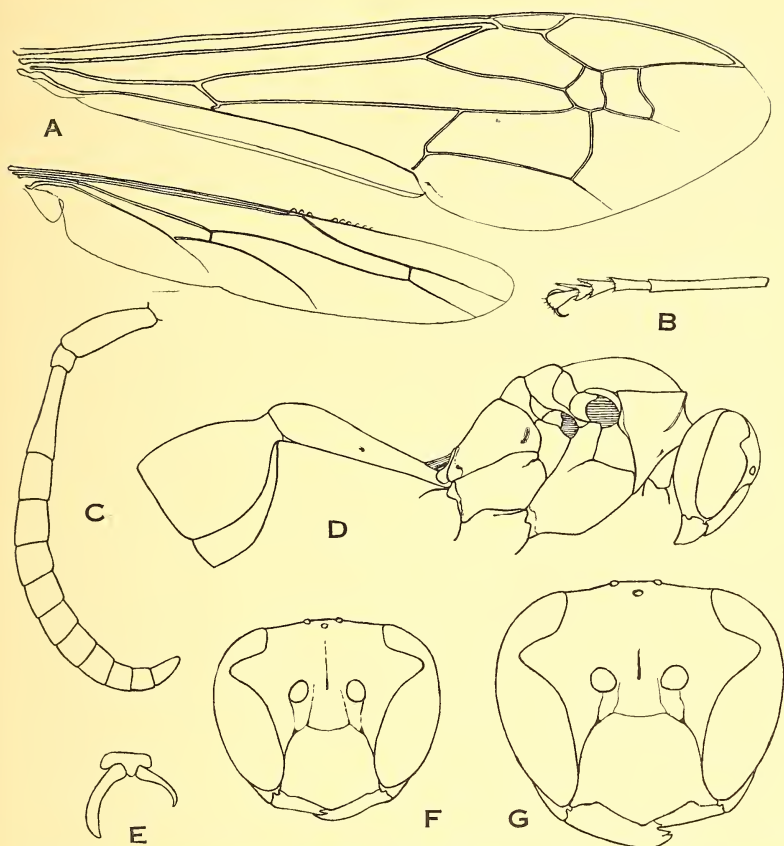


FIG. 4. *Mischoyttarus cubensis* (H. de Saussure): A, wings of female; B, hind tarsus of female; C, antenna of male; D, body of female in profile; E, hind claw of female; F, head of male; G, head of female. Female from Trinidad Mts., Cuba; male from St. Simon's Island, Georgia.

strongly asymmetrical, one of the claws in each pair nearly twice as long as, and much thicker than, the other; mid tibiae with two spurs. Body dull, with microscopic, alutaceous sculpture; under a hand-lens it appears to be impunctate, except for a few coarse pits on the median, apical lobe of the clypeus and on the mandibles. Pubescence very fine, short and appressed; apical third of clypeus, mandibles, and outer surface of tibiae with longer and stouter erect hairs; hind tibiae with the usual brush of shiny hairs on the under side near the apex. Venation as usual in the genus.

Male.—Differs from the queen and worker only in the following points: head hardly emarginate behind; genae shorter and not swollen behind the eyes, not quite half as wide as the eye in profile; upper lateral margins of clypeus touching the eyes over about two-thirds of their length, the lower lateral margins forming almost straight lines from the bases of the mandibles to the broadly curved apex which projects very little; antenna more slender, of thirteen segments: scape relatively more swollen and about as long as the third segment; fourth to thirteenth segments slightly flattened on the under side over a narrow area; twelfth about as long as wide; thirteenth conical, bluntly pointed at apex, one and one-third times the length of the twelfth; flagellum straight, not curled; seventh abdominal tergite and sternite broadly rounded at apex, the tergite normally convex, the sternite slightly flattened in its apical half.

Length (h + th. + t. 1 + 2): queen and worker, 8 to 11 mm.; male, 8 to 10.5 mm. Length of fore wing, 7.5 to 12 mm.

Coloration.—After studying considerable material of Central American *Mischocyttarus*, I have reached the conclusion that de Saussure's *Polybia mexicana* was based upon a color variant of *M. cubensis*. At any rate, I am unable to find any structural characters, in either sex, that would enable one to separate the Mexican and Central American specimens which I refer to *mexicana* from *cubensis* of Florida and Cuba.

The queens and workers of the two color forms may be separated as follows:

KEY TO COLOR FORMS

- Ground color of head, thorax and abdomen rather uniformly reddish brown, exceptionally with a few black blotches (more often on the propodeum and pectus). Pleura and pectus spotted with yellow, but not mostly of that color. Wings extensively tinged with amber yellow and usually darkened in the radial cell typical *cubensis*.
- Ground color of vertex and mesonotum blackish brown to black, generally contrasting with that of the abdomen which varies from orange yellow through ferruginous to blackish brown. Pleura and pectus often almost entirely yellow. Wings nearly hyaline var. *mexicanus* (H. de Saussure).

The male of the typical form differs little in color from the queen and worker; but of the few males of the var. *mexicanus* I have seen, some are colored like the worker, while others have the

abdomen dorsally blackish brown with apical yellow fasciae (extending along the sides of the tergites and angularly expanded on the sides of the second tergite) and ventrally almost wholly yellow.

Distribution.—Typical *M. cubensis* occurs in southeastern Georgia, throughout Florida (except the northwestern portion), the Bahamas and Cuba, and possibly in Jamaica. It is fairly common over most of this territory; but there are as yet very few records from the Bahamas. References to *M. cubensis* from Santo Domingo and Porto Rico are, in my opinion, based upon erroneous identifications, since all the specimens I have seen from those islands (as well as from St. Croix) were *M. phthisticus* (Fabricius).

On the American continent, *M. cubensis* var. *mexicanus* is known thus far only from southern Mexico, Guatemala, and the Republic of Honduras; but quite likely it is more widely distributed. It seems, however, to be restricted to the Atlantic drainage. At present it is not known how far north it extends.

Ethology.—Our knowledge of the habits of *M. cubensis* is as yet very meager. Cresson (1865) mentioned that the nest of the typical form, in Cuba, is in general shape similar to that of *Icaria variegata* H. de Saussure (1853, Et. Fam. Vesp., II, P. 25, Pl. IV, figs. 3–3a; this was *Icaria artifex* H. de Saussure, not *I. variegata* F. Smith), from Java. Ashmead (1894) noted that, in Florida, *M. cubensis* builds a papery comb (like that of *Polistes*), not enclosed in a covering, and attached to a twig of a low tree.

A beautiful nest of typical *cubensis* (Pl. XXIX, Figs. 5 and 6) was collected by G. B. Fairehild and D. M. Bates at Baragua, Cuba, June 20, 1932. It was found at the wooded, swampy margin of a stream, hanging down from Spanish moss (*Tillandsia*) some six feet above the ground. From below, the single, openly exposed comb is irregularly oval in outline, 28 mm. long and 21 mm. wide. In profile, it is cap-shaped, the peripheral cells starting at lower levels than those of the center. The short and thin stalk is about central and the nest was placed vertically, with all cells opening downward. There are some 37 cells in all, most of them incomplete. Four of the cells are capped over, but they are of very unequal height (15, 13, 11 and 10 mm. respectively). When completed, the hexagonal cells are 3.5 mm. across. The nest is pale brown, solid and of a coarser texture than that of *M. flavitarsis*. The material of which it is built contains very few fibers, but consists rather of flat pieces of plant tissue, probably taken from leaves and not from wood. Four female wasps, all exactly of the same size, shape and color, were found resting on the comb.

I have taken the male at flowers of *Lantana Camara* Linnaeus, in Cuba. Also in Cuba, this wasp is homeomorphic with (or "mimicked" by) the syrphid fly, *Salpingogaster punctifrons* Curran, as observed by me at Banes and by Mr. P. J. Darlington near Soledad.

M. cubensis, typical form

Polybia cubensis H. de Saussure, 1853-1855, Et. Fam. Vesp., II, p. 202, Pl. XXV, figs. 5, 5a and 6 (♀ ♂; Cuba; holotype ♀ and allotype ♂ in Paris Museum); 1856, in de la Sagra, Historia Fis. Pol. Nat. Cuba, Segunda Parte, VII, p. 324; 1857, in de la Sagra, Histoire Phys. Pol. Nat. Cuba, VII, p. 774 (♀). F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 130. Cresson, 1865, Proc. Ent. Soc. Philadelphia, IV, p. 167 (♀ ♂). Gundlach, 1886, Contrib. Entom. Cubana, II, p. 156. Fox, 1890, Ent. News, I, p. 93. Dalla Torre, 1894, Cat. Hym., IX, p. 163. Ashmead, 1894, Psyche, VII, p. 76; 1896, Bull. Labor. Nat. Sci. State Univ. Iowa, IV, No. 1, p. 31; 1900, Trans. Ent. Soc. London, p. 311 (in part). Lewis, 1897, Trans. Amer. Ent. Soc., XXIV, p. 191 (♀). Dalla Torre, 1904, Gen. Insect., Vesp., p. 77.

Megacanthopus cubensis Ducke, 1908, Deutsch. Ent. Zeitschr., p. 698 (♂). Meade-Waldo, 1911, Ann. Mag. Nat. Hist., (8) VII, p. 111.

Polybia phthisica Cresson, 1865, Proc. Ent. Soc. Philadelphia, IV, p. 167 (♀ ♂). Gundlach, 1886, Contrib. Entom. Cubana, II, p. 155. Not *Vespa phthisica* Fabricius, 1793.

Specimens Examined.—GEORGIA: Billy's Island, Okefenokee Swamp; St. Simon's Island (J. C. Bradley.—Cornell Univ.).—FLORIDA: Gainesville, Alachua Co.; Silver Springs, Marion Co. (Geo. P. Engelhardt); Orlando, Orange Co. (A. L. Melander); Kissimmee, Osceola Co. (A.M.N.H.); Tampa, Hillsborough Co. (E. L. Bell); Naples, Collier Co. (G. B. Fairchild); Ft. Lauderdale, Broward Co. (D. M. Bates); Miami, Dade Co. (E. L. Bell); Key Largo; Metacumbe Key; Key West (G. N. Collins and C. L. Pollard.—A.M.N.H.).—BAHAMAS: without more definite locality (Acad. Phila.); Nassau, New Providence (A.M.N.H.). Ashmead records *cubensis* from Eleuthera.—CUBA: without more definite locality (Acad. Phila.); San Carlos Est., Guantánamo (A.M.N.H.); Estación Central Agronómica de Cuba (Acuña.—U.S.N.M.); Mina Carlota, Trinidad Mts., one male, March 20, 1905 (George Salt); San José, Trinidad Mts., August 1930 (R. P. Dow); Camagüey (J.

Acuña); Santiago de las Vegas; Taco-Taco (S. B. Bruner and O. H. Ballou); Tacajo near Banes, Oriente (J. Bequaert); Baragua, Camagüey, June 20, 1932, with nest (G. B. Fairchild and D. M. Bates); "Las Ánimas," 500 m., Sierra de Rángel, Santa Cruz de los Pinos, Prov. Pinar del Río (C. G. Aguayo); Isle of Pines.

I have seen a few specimens of *M. cubensis*, at the Imperial Institute of Entomology (London) and at the Laboratory of Entomology of the Dept. of Agriculture of Jamaica, labelled "Hope Gardens, Jamaica." This record, however, appears questionable, since no other entomologist has ever taken this wasp in the island.

Queen and Worker.—Reddish brown (Ridgway's auburn to chestnut), with the following parts yellow (Ridgway's light cadmium): clypeus (except the narrow, dark-brown margin); a broad band bordering the inner orbits, touching the antennal socket, filling the ocular sinuses, and extending from the clypeus to the vertex, where the two lines converge so as nearly to meet in the middle line; a very broad band on the cheeks margining the outer orbits from the base of the mandibles to the vertex, but not quite meeting the inner orbital band; two large spots above and between the insertions of the antennae, not quite meeting in the middle; a small spot just below the insertion of each antenna; sometimes a single spot just below the median ocellus; mandibles, except their teeth; anterior and posterior margins of the pronotum; two longitudinal lines on the mesonotum (sometimes obsolete or completely absent); a large spot under the insertion of the wings and another on the mesepisternum above the coxa; narrow anterior margins of scutellum and postscutellum and several dots at their lateral extremities near the base of the posterior wings; two or four longitudinal lines on the posterior half of the propodeum; apical margins of some or all abdominal segments to varying widths and either continuous on the sternites or not; most of the tarsi, tibiae, and tips of the femora, together with spots on the coxae. Thorax darker reddish brown than the abdomen, the pleura being very dark or almost black in some specimens. Basal half of the petiole much darker than the apical portion, and the coxae, trochanters, and most of the femora very dark brown. Antennae ferruginous throughout in some specimens, in others darker in the middle above and almost yellowish at the tip. Wings more or less tinged with amber yellow, especially along the anterior margin, basally hyaline, apically smoky; median and radial cells darker. The clypeus of some specimens bears in the middle a line of light red, which sometimes is much broader and this color may even cover the entire clypeus.

Male.—Coloration similar to that of the female and likewise somewhat variable.

M. cubensis var. *mexicanus* (H. de Saussure)

Polybia mexicana H. de Saussure, 1853–1855, Et. Fam. Vesp., II, p. 203, Pl. XXVI, figs. 6 and 6a (♀; Mexico; type in Paris Museum). F. Smith, 1857, Cat. Hym. Brit. Mus., V, p. 130. Dalla Torre, 1894, Cat. Hym., IX, p. 164; 1904, Gen. Insect., Vesp., p. 78. W. A. Schulz, 1905, Hymenopteren-Studien, p. 132 (♀).

Specimens Examined.—MEXICO: several females, workers and males without more definite locality (Acad. Phila.).—GUATEMALA: Palinque, one female (H. W. Atkinson).—REPUBLIC OF HONDURAS: Tegucigalpa, one worker (F. J. Dyer); Puerto Castilla, one female; Prieta, one male (J. Bequaert).

W. A. Schulz (1905) records *P. mexicana* from Popayán, Colombia. This identification is open to doubt, since I have seen a somewhat similar, but apparently distinct species from Panamá. He claims that Fox's specimens of "*mexicana*" from Rio de Janeiro, Brazil, (1898, Proc. Acad. Nat. Sci. Phila., p. 451) could not have been that species. Most probably they were *M. alfenii* Duke, which, as I have pointed out above, is perhaps not distinct from *M. cubensis* var. *mexicanus*. Ashmead's *Polybia mexicana* (1900, Trans. Ent. Soc. London, p. 311), from Porto Rico, refers to *Mischocyttarus phthisicus* (Fabricius), the only Polybiine wasp known from that island.

Polybia mexicana R. v. Ihering (1904, Rev. Mus. Paulista, VI, pp. 186 and 251), from southern Brazil, was *Polybia oecodoma* H. de Saussure, as recognized by Duke.

The color characters separating this Central American form from typical *cubensis* have been indicated in the key. The pattern and main tinge of the abdomen vary from pale brownish or orange red, with few yellow markings, to russet or blackish brown, with conspicuous yellow bands. In the males, the russet color of the body is almost entirely replaced by black. In all specimens seen, of both sexes, the mesonotum is brownish black or black with two curved longitudinal yellow stripes, which do not reach the front and hind margins. The var. *mexicanus* averages slightly larger than the typical form of the species.

ACKNOWLEDGMENTS

I have studied specimens of North American Polybiinae belonging to the following public collections: American Entomological

Society (at the Academy of Natural Sciences, Philadelphia, through Mr. E. T. Cresson, Jr.); American Museum of Natural History, New York (through Dr. F. E. Lutz and Mr. H. F. Schwarz); Brigham Young University, Provo, Utah (through Prof. V. M. Tanner and Mr. C. L. Hayward); California Academy of Sciences, San Francisco (through Dr. E. P. Van Duzee); Department of Agriculture of Canada, Entomological Branch (through Mr. G. S. Walley); Entomological Department of Cornell University, Ithaca, N. Y. (through Prof. J. C. Bradley); Museum of Comparative Zoölogy, Cambridge, Mass. (through Mr. N. Banks); Oregon Agricultural Experiment Station, Corvallis, Oregon (through Prof. H. A. Scullen); and United States National Museum (through Miss Grace Sandhouse); of private collectors I am particularly indebted to Mr. D. M. Bates, Mr. Richard Dow, Mr. G. B. Fairchild, Mr. Max H. Ruhmann, Professor G. J. Spencer, Mr. C. Lynn Hayward, Dr. George Salt, and Mr. H. F. Schwarz.³² I am also under obligation to Mr. H. F. Schwarz and Miss Grace Sandhouse for much help and valuable suggestions. The photographs of the nests of *Nectarina lecheguana* and *Mischocyttarus flavitarsis* var. *navajo* I owe to the courtesy of the American Museum of Natural History (through Dr. F. E. Lutz and Mr. H. F. Schwarz); while those of *M. flavitarsis* (typical) and *M. cubensis* were made by Mr. D. W. Farquhar.

³² Since the MS was sent to the printer, a large collection of *Mischocyttarus* was sent for study by the Department of Entomology, University of Kansas (through Mr. J. M. Brennan).

PLATE XXVII

Side view of nest of *Nectarina lecheguana* (Latreille), taken at Brownsville, Texas, by Mr. Herbert F. Schwarz and Dr. F. E. Lutz. A 20 cm. scale placed along the basal end. Courtesy of American Museum of Natural History, New York.

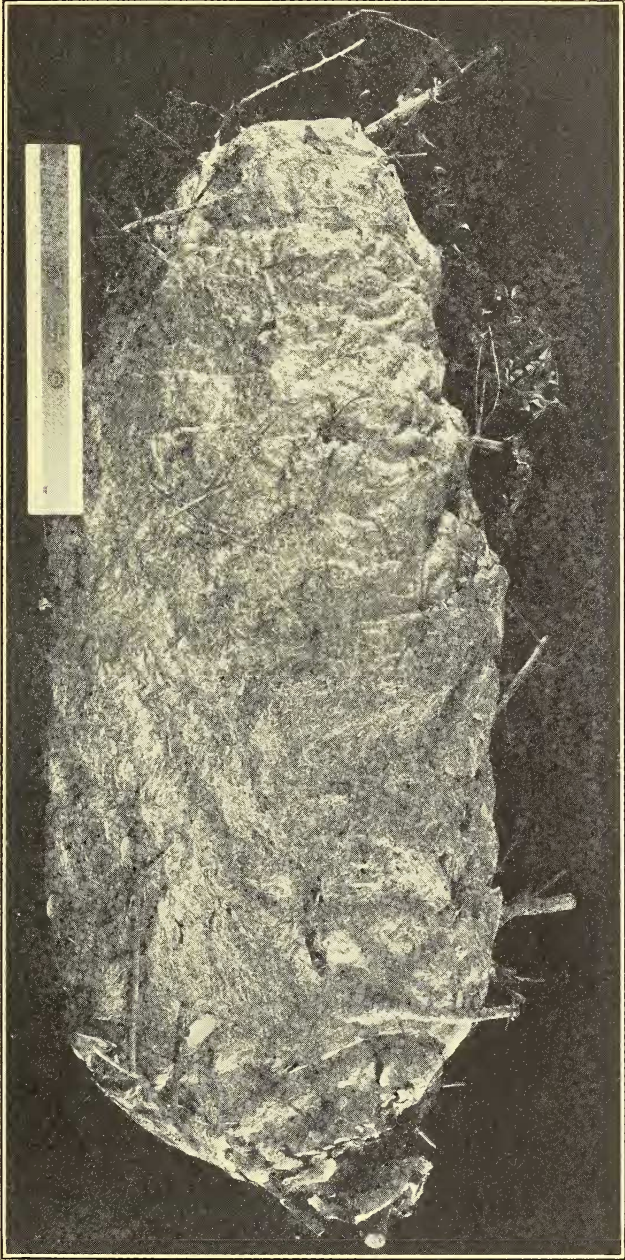


PLATE XXVIII

Apex of the same nest of *Nectarina lecheguana* (Latreille), shown in Plate XXVII. Courtesy of American Museum of Natural History, New York.

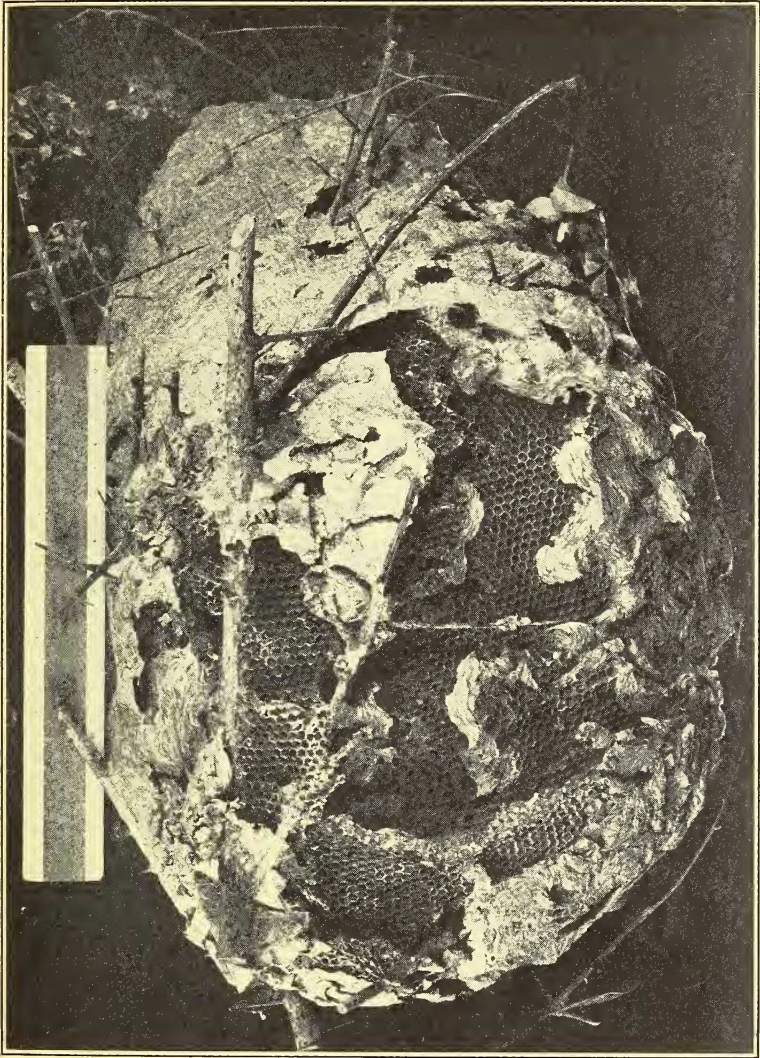


PLATE XXIX

Figs. 1 and 2. Nest of *Mischocyttarus flavitarsis* var. *navajo* J. Bequaert, taken by Dr. F. E. Lutz in the Santa Catalina Mts., Arizona; from the side and below. Natural size. Courtesy of American Museum of Natural History, New York.

Figs. 3 and 4. Nest of *Mischocyttarus flavitarsis* (H. de Saussure), typical form, taken by Prof. H. A. Scullen near Corvallis, Oregon; from the side and below. Natural size. Photographs by D. W. Farquhar.

Figs. 5 and 6. Nest of *Mischocyttarus cubensis* (H. de Saussure), taken by Mr. G. B. Fairchild and Mr. D. M. Bates at Baragua, Cuba; from the side and below. Natural size. Photographs by D. W. Farquhar.